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Volume I, Studies 1–7

by

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ABSTRACT

This document compiles all available data from the IERL Phased Environmental Assessment Program for the period February 1978 through March 1979. This document follows an earlier publication, EPA-600/2-78-211, Compilation of Level 1 Environmental Assessment Data, which compiled all available chemical data from the inception of the Environmental Assessment Program through March 1978.

Available data from 14 environmental assessment studies are compiled in this document in standard formats. The formatted Level 1 data are organized within each study by the analytical technique used to generate the data. Inorganic data as generated by spark source mass spectroscopy, atomic absorption, gas chromatography, chemiluminescence for oxides of nitrogen, anion analysis, and aqueous analysis precede the organic data generated by gas chromatography for C_1-C_6/C_7 or C_7-C_{17}, liquid chromatographic fractionation, infrared spectroscopy, and low resolution mass spectroscopy. Sampling and analytical techniques that were used that are not specified in Level 1 are documented in the summaries and data pages.

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INTRODUCTION

This document is an accumulation of all available environmental assessment data published from February 1978 through March 1979.

This document is the second comprehensive compilation of data from the IERL Phased Environmental Assessment Program. The first data compilation was published in October 1978 as EPA-600/2-78-211, Compilation of Level 1 Environmental Assessment Data. As in the first data compilation, the primary purpose of this compilation is to permit those involved in environmental assessment programs to evaluate the quality and quantity of data generated by the phased approach. It is felt that critical reviews of these data may lead to improvements in procedures, data formatting, data storage, and data interpretation. Although conclusions related to specific sources or source types may have been abstracted from the references to provide background information, the focus of this presentation is on data resulting from the Level 1 sampling and analytical methods. The interested reader should consult the referenced documents for more details and conclusions concerning pollutant sources, control techniques, etc.

The phased environmental assessment program, developed by the Industrial Environmental Research Laboratory (IERL) of the Environmental Protection Agency (EPA) at Research Triangle Park (RTP), North Carolina, is divided into three levels. Level 1 is the survey step to determine which samples from an environmental assessment might be hazardous or toxic. Level 1 also serves to establish the priority of samples and rank samples for further testing. When the Level 1 sampling and analysis scheme shows the possible presence of hazards, a Level 2 scheme is initiated to specifically identify and quantify suspected hazardous materials. If Level 2 reveals pollutants capable of environmental detriment, then a Level 3 scheme is begun to evaluate control technologies and to assess long-term effects.

Fourteen studies have been identified that contain phased environmental assessment data; these studies are organized alphabetically by source types in this compilation. It should be noted that each study included in this compilation will be identified as final draft, preliminary draft, etc., based on the completeness of the study summarized; therefore, absence of data does not necessarily indicate analysis was not performed but that the study was possibly not complete when it became necessary to compile the data. In each study, mention is made of methods used if they differ from the methodology specified in the IERL-RTP Procedures Manual: Level 1 Environmental Assessment (Second Edition), EPA-600/7-78-201.

Within each study, information is organized in the following manner:

I. Summary of the study

II. Level 1 data

  A. Inorganic analysis data

    1. Spark source mass spectroscopy (SSMS)
    2. Atomic absorption (AA) wet chemical methods--Hg, As, Sb
    3. Gas chromatography for inorganic gases
    4. Chemiluminescence for NO_x
    5. Anion analysis
    6. Aqueous analyses for pH, acidity, alkalinity, BOD, COD, DO, conductivity, dissolved and suspended solids, and other selected physical parameters

  B. Organic analysis data

    1. Gas chromatography for gases, b.p. <100° C (C_1-C_7)
    2. Gas chromatography for gases, b.p. >100° C (C_1-C_{17})
    3. LC fractionation
    4. IR
    5. Low resolution mass spectrometry (LRMS)

III. Level 2 data

IV. Additional data

Data in categories III and IV are photocopied from the referenced documents. Level 1 data are presented in standard format.

STUDY NUMBER 1

DATA SOURCE:	**LEVEL 2 CHEMICAL ANALYSIS OF FLUIDIZED-BED COMBUSTOR SAMPLES**
DATA STATUS:	EPA–600/7-79-063b, February 1979
AUTHORS: CONTRACTOR:	L. E. Ryan, R. G. Beimer, and R. F. Maddalone TRW, Inc. Defense and Space Systems Group One Space Park Redondo Beach, California 90278
PROJECT OFFICER:	Walter B. Steen Industrial Environmental Research Laboratory Office of Energy, Minerals, and Industry U.S. Environmental Protection Agency Research Triangle Park, NC 27711

This report presents results of a preliminary Level 2 chemical analysis, conducted by TRW on a set of particulate samples from the Battelle 6-in. fluidized-bed combustion (FBC) unit. This Level 2 effort followed the approach described in a previous document by TRW,[1] and was a test of newly developed procedures and techniques. These particulate samples plus other samples from the FBC miniplant had been collected and analyzed by a Level 1 protocol by Battelle Columbus Laboratories (BCL). The samples subjected to Level 2 were from BCL's sampling run No. 2. The BCL study[2] was summarized in a previous data compilation[3] as Study No. 12, which contains schematics and process descriptions.

The TRW report also presents an analysis of decision criteria for proceeding from Level 1 to Level 2 and a detailed series of flow charts for the application of Level 2 inorganic analytical techniques. Tables 1-1 and 1-2 (from the document) summarize the organic and inorganic Level 1 data assessments and Level 2 chemical analyses.

The Level 2 inorganic analysis scheme was divided into three phases and results for each phase were summarized as follows:

I. Initial Sample Characterization

Samples were found to be "highly stable and mostly inorganic in composition; relatively uniform in morphology; and without optically identifiable crystalline materials." Atomic absorption spectrophotometry adequately quantitated cations present in the samples.

II. Bulk Composition Characterization

The samples were found to contain these major constituents: Fe_2O_3, SiO_2, $CaSO_4 \cdot 2H_2O$, $CaSO_4 \cdot \frac{1}{2}H_2O$, $CaSO_4$ (anhydrous) CaS, CaO, and $CaCO_3$ (vaterite and calcite forms).

III. Individual Particle Characterization

Bulk composition results were confirmed. Discrete respirable particles of SiO_2 were also identified.

Detailed discussions of inorganic analytical techniques were presented.

TABLE 1-1. ORGANIC SUMMARY

Level 1 assessment			Level 2 data			
Level 1 organic liquid chromatographic (LC) fraction requiring Level 2 analysis	MEG categories sought in Level 2		MEG compounds identified		μg/m³ concentration	
	Probable category	μg/m³ concentrations*	MEG category	MEG compound	PER compound	Total PER LC fractions
LC 1	Organometallics	7.6×10^2	Aliphatic hydrocarbons	Alkanes (C > 9)	1.9×10^3	1.9×10^3
LC 2 and 3	Unsaturated alkyl halides	1.3×10^3	Aliphatic hydrocarbons	Alkanes (C > 9)	7.7×10^2	
	Halogenerated		Esters	Phthalates**	1.2×10^2	
	Aromatic hydrocarbons		Fused aromatic hydrocarbons	1,2 Benzanthracene	2.8×10	
	Benzene, substitute					
	Benzene			Phenanthrene	1.7×10^2	1.5×10^3
				Methyl anthracene	1.2×10^2	
	Fused aromatic hydrocarbons			Pyrene	3.5×10	
	Fused nonalternate polycyclic hydrocarbons			Naphthalene	1.5×10	
			Fused nonalternate polycyclic hydrocarbons	Benzo fluoranthene, fluoranthene	1.9×10	
LC 4 and 5	Heterocyclic sulfur	6.6×10^2	Esters	Phthalates**	2.1×10^3	2.1×10^3
LC 6 and 7	Amines	1.2×10^3	Esters	Phthalates**	8.7×10^2	
	Mercaptans, sulfides		Unknown (1)	Molecular weight 176		
	Halophenols					
	Nitrophenols				2.4×10^2	2.0×10^3
	Heterocyclic		Unknown (2)	Hydrocarbons		
				Molecular weight 394		
	Nitrogen				8.7×10^2	

*These are the concentrations determined by the Level 1 analytical effort.

**Only compound which EXCEEDS MATES

TABLE 1-2. INORGANIC SUMMARY

Inorganic MEG category requiring Level 2 analyses	Level 1 assessment: MEG compounds sought in Level 2		Level 2 data	
	Probable compound	μg/m³ concentration*	MEG compounds identified (indicated)	μg/m³ concentration
Lithium	Li, Li^+, Li_2CO_3	2.3×10^2	Li, Li^+	6.3×10^2 exceeds MATE
Sodium	Na^+	5.7×10^4	Na^+, (Na_2O)	5.4×10^5 exceeds MATE
Potassium	K^+	2.6×10^5	K^+	6.7×10^4
Beryllium	Be^{++}, BeO, $BeO \cdot Al_2O_3 \cdot SiO_2$	4.1	none detected	
Magnesium	Mg^{++}, MgO, $MgSO_4$, $MgCO_3$, $MgCO_3 \cdot CaCO_3$	9.8×10^4	(MgO), Mg^{++}, ($MgSO_4$)	7.3×10^4 (as Mg) exceeds MATE
Calcium	Ca^{++}, $CaCO_3$, $CaSO_4$	1.3×10^6	Ca^{++}, $CaCO_3$, $CaSO_4$, CaS, (CaO)	9.5×10^5 (as Ca) exceeds MATE
Strontium	Sr^{++}, $SrSO_4$	4.3×10^3	Sr^{++}, ($SrSO_4$)	1.4×10^4 (as Sr) exceeds MATE
Barium	Ba, $BaCO_3$, $BaSO_4$	1.6×10^4	none detected	
Aluminum	Al^{+3}, Al_2O_3, $Al_2O_3 \cdot 3H_2O$	9.4×10^5	Al^{+3}, (Al_2O_3)	5.2×10^4 (as Al) exceeds MATE
Thallium	Tl	1.6×10^2	none detected	
Silicon	SiO_4^{-2}, SiO_3^{-2}, SiO_2, SiC	3.5×10^6	Si, (SiO_3^{-2}), SiO_2	1.3×10^2 (as Si) exceeds MATE
Lead	Pb^{+2}, Pb^{+4}, PbO, $PbSO_4$, $PbCO_3$, $Pb_3(PO_4)_2$	9.5×10^2	Pb^{+2}, ($PbSO_4$, $PbCO_3$)	3.3×10^3 (as Pb) exceeds MATE
Nitrogen	NO_3^-, NO_2^-	1.8×10^5	(NO_3^-, NO_2^-)	not determined
Phosphorus	PO_3^{-3}, PO_4^{-3}	1.1×10^3	not detected	
Arsenic	As^{+3}, As^{+5}, AsO_4^{-3}, AsO_3^{-3}, As_2O_3	2.3×10^1	As, (AsO_4^{-3}, As_2O_3)	5.0×10^{-1} (as As)

TABLE 1-2. (continued)

Inorganic MEG category requiring Level 2 analyses	Level 1 assessment		Level 2 data	
	MEG compounds sought in Level 2			
	Probable compound	μg/m³ concentration*	MEG compounds identified (indicated)	μg/m³ concentration
Sulfur	S^{-2}, SO_4^{-2}, SO_3^{-2}	2.2×10^4	S^{-2}, SO_4^{-2}, SO_3^{-2}	not determined
Yitrium	Y^{+3}	8.5×10^3	none detected	
Titanium	Ti^{+3}, Ti^{+4}, TiO_2	2.7×10^4	none detected	
Zirconium	Zr^{+4}, ZrO_2	3.5×10^3	Zr^{+4}, (ZrO_2)	2.0×10^1 (as Zr)
Vanadium	V^{+3}, VO^{+2}, VO_4^{-4}, VO_3, VO, VO, V_2O_3, V_2O_4, V_2O_5, $VOSO_4 \cdot 5H_2O$	9.8×10^3	V, (VO_4^{-4}, V_2O_3, V_2O_4, V_2O_5, $VOSO_4 \cdot 5H_2O$)	2.6×10^3 (as V) exceeds MATE
Chromium	Cr^{+2}, Cr^{+3}, CrO^{-2}, $Cr\ O^{-2}$, Cr_2O_3, FeO Cr_2O_3, $FeCrO_4$	2.1×10^3	Cr, Cr^{+2}, Cr^{+3}, (CrO^{-2}, $Cr\ O^{-2}$, Cr_2S_3, CrO_3	8.3×10^3 (as Cr) exceeds MATE
Manganese	Mn^{+2}, Mn^{+3}, MnO_4, MnO, MnO_2, $MnCO_3$, $MnSO_4$	3.8×10^3	Mn^{+2}, Mn^{+3}, (MnO_4, MnO_2, $MnCO_3$, $MnSO_4$)	1.3×10^2 (as Mn)
Iron	Fe^{+2}, Fe^{+3}, $FeO \cdot Fe_2O_3$, FeS, Fe_2O_3, $KFeSi_2O_6$	4.3×10^5	Fe^{+3}, Fe_2O_3, (FeS)	5.6×10^2 (as Fe)
Cobalt	CO^{+2}, CO^{+3}, $CoCo_3 \cdot 4H_2O$, CoO	1.9×10^2	none detected	
Rhodium	Rh^{+3}	2.1×10^2	none detected	
Nickel	Ni^{+2}, Ni^{+3}, NiO	3.8×10^3	none detected	
Copper	Cu^{+}, Cu^{+2}, CuO, Cu_2O, $CuSO_4$, $CuCO_3$	9.7×10^2	Cu^{+}, Cu^{+2}, (CuO, $CuSO_4$, $CuCO_3$)	4.6×10^1 (as Cu)

TABLE 1-2. (continued)

Inorganic MEG category requiring Level 2 analyses	Level 1 assessment: MEG compounds sought in Level 2: Probable compound	Level 1 assessment: MEG compounds sought in Level 2: µg/m³ concentration*	Level 2 data: MEG compounds identified (indicated)	Level 2 data: µg/m³ concentration
Cadmium	Cd^{+2}, CdO	$<6.0 \times 10^1$	Cd	5.0 (as Cd)
Uranium	U	6.4×10^1	not determined	
Silver	not required		Ag	3.9×10^2 (as Ag) exceeds MATE
Zinc	not required		Zn, (ZnO, $ZnSO_4$, ZnS)	6.6×10^3 (as Zn) exceeds MATE
Mercury	not required		Hg	9.3×10^2 (as Hg) exceeds MATE

*These are the concentrations determined by the Level 1 SSMS. The SSMS Level 1 data are not expected to be accurate for major components (>100 ppm, $>5 \times 10^4$ µg/m³).

The Level 2 organic analysis was performed according to the scheme outlined in Figure 1-1 (from the report). Table 1-3 (from the report) summarizes results of the organic analysis.

Samples in the data tables are encoded as follows:

S-2-1	Illinois Coal No. 6 (feed coal)
S-2-2	Grove Limestone (feed for sorbent bed)
S-2-3	Overflow Bed Material > 325 mesh
S-2-4	Overflow Bed Material < 325 mesh
S-2-5	Sludge (solids from aqueous scrubber system in effluent gas line)
S-2-6	Particulates > 27 μ (from process cyclone)
S-2-7	Particulates < 27 μ (from cyclone and filter of a modified Method 5 train)

An A or B after the sample code number indicates an acidic or basic leachate. A number indicates an LC fraction number.

In this study, Level 2 analysis was run where the Level 1 analysis was within a factor of three of the appropriate MATE value. All Level 1 and Level 2 data are presented in the TRW Level 1-Level 2 data reduction tables. The table titled "Total Emission Data" is the summation of results from samples S-2-5, S-2-6, and S-2-7.

Results of the following Level 2 analytical techniques are reported in the "initial sample characterization" phase.

1. Photomicrographs of particulates
2. Descriptions of particulates as observed through a microscope
3. Thermal gravimetric analysis (TGA)
4. Atomic absorption spectrophotometry (AA)
5. Induction coupled plasma optical emission spectroscopy (ICPOES)

Results from quantitation of cations by AA and ICPOES were combined with a list of possible compounds for the processes involved and were used to estimate the quantities of these compounds present in the samples.

The "bulk composition characterization" phase of the inorganic analysis utilized these methods:

1. Fourier transform infrared (FTIR)
2. Electron spectroscopy for chemical analysis (ESCA)
3. X-ray powder diffraction (XRD)

Results of this phase were used to confirm or refute the presence of compounds from the list of possible compounds generated in the initial phase.

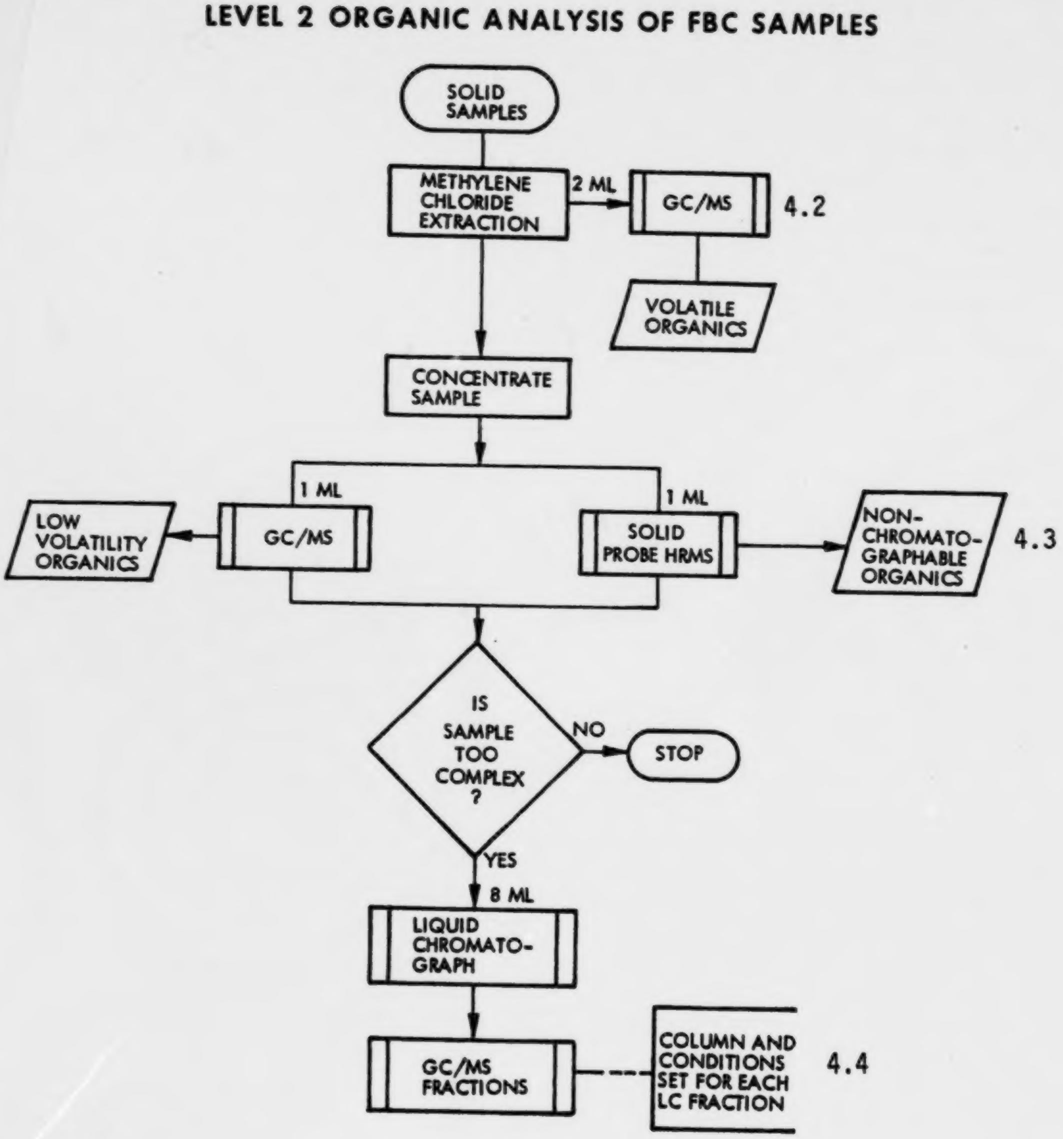
LEVEL 2 ORGANIC ANALYSIS OF FBC SAMPLES
SOLID SAMPLES
METHYLENE CHLORIDE EXTRACTION
2 ML
GC/MS
4.2
VOLATILE ORGANICS
CONCENTRATE SAMPLE
1 ML
1 ML
LOW VOLATILITY ORGANICS
GC/MS
SOLID PROBE HRMS
NON-CHROMATO-GRAPHABLE ORGANICS
4.3
IS SAMPLE TOO COMPLEX ?
NO
STOP
YES
8 ML
LIQUID CHROMATO-GRAPH
GC/MS FRACTIONS
COLUMN AND CONDITIONS SET FOR EACH LC FRACTION
4.4

Figure 1-1. Level 2 organic analysis scheme.

TABLE 1-3.

MEG category		Compound	MATE air $\mu g/m^3$	FBC emission samples* $\mu g/m^3$	Comments
1.	Aliphatic hydrocarbons	Alkanes (C>9)	N	8.0×10^2	No MATE available for assessment
8D.	Esters	Phthalates	5.00×10^3	3.1×10^4	Exceeds MATE
21.	Fused aromatic hydrocarbons	Benza(a)anthracene	4.45×10	2.8×10	Does not exceed MATE
		Phenanthrene	1.59×10^3	1.7×10^2	Does not exceed MATE
		Naphthalene	5.00×10^4	1.5×10^2	Does not exceed MATE
		Anthracene, methyl anthracene	5.60×10^4	1.2×10^2	Does not exceed MATE
		Pyrene	2.33×10^5	3.5×10	Does not exceed MATE
22.	Fused non-alternate polycyclic hydrocarbons	Benzofluoranthene	6.48×10^3	1.0×10	Does not exceed MATE
		Fluoranthrene	9.00×10^4	1.3×10^2	Does not exceed MATE

*Summation of S-2-5, S-2-6, and S-2-7.

The "individual particle characterization" phase used these analytical methods:

1. Scanning electron microscopy (SEM) with energy dispersive analysis of X-rays (EDX)
2. Electron beam microprobe (EPMA)
3. Transmission electron microscopy (TEM)
4. Selected area electron diffraction (SAED)

SEM-EDX and EPMA results generally confirmed the results from earlier phases. TEM-SAED results were inconclusive except for sample S-2-3, which showed respirable particles of silica.

Level 2 organic analysis was performed using the following techniques:

1. Gas chromatography/mass spectrometry (GC/MS) [with impact (or EI) ionization]
    - Performed on unfractionated CH_2Cl_2 extract for general characterization and quantitation plus identification of some specific polynuclear organic materials (POM).
    - Performed on fractionationated samples from the CH_2Cl_2 concentrate to characterize low-volatility components.
2. Solid probe low resolution mass spectrometry (LRMS)
    - Performed on concentrated CH_2Cl_2 extract to determine nonvolatile components.
3. GC/MS [with chemical (or CI) ionization]
    - Performed on LC fractions where components were not identified by GC/MS/EI techniques.

It was noted that GC/MS/CI was of little value in identifying compounds that could not be detected by GC/MS/EI.

REFERENCES

1. L. E. Ryan, R. G. Beimer, and R. F. Maddalone, Approach to Level 2 Analysis Based on Level 1 Results, MEG Categories and Compounds and Decision Criteria, EPA Contract #68-02-26-13, 1978.
2. J. M. Allen, J. E. Howes, Jr., S. E. Miller, and K. M. Duke, Comprehensive Analysis of Emissions from Exxon Fluidized-Bed Combustion Miniplant Unit, Draft dated September 9, 1977, EPA Project Officer D. B. Henschel.
3. N. H. Gaskins, and F. W. Sexton, Compilation of Level 1 Environmental Assessment Data, EPA-600/2-78-211, October 1978.

LEVEL 1

TABLE 1-4. ATOMIC ABSORPTION (AA) ANALYSIS
($\mu g/g$)

Sample	As	Hg	Sb
S-2-3		<0.8	
S-2-4		*	
S-2-5		441	
S-2-6		12	
S-2-7-2		176	
S-2-7-3		87	

*Not determined. Based on MATE values, this was not required in the Level 2 effort.

TABLE 1-5. ATOMIC ABSORPTION (AA) ANALYSIS
(mg/L)

Sample	As	Hg	Sb
Acidic solution			
S-2-1-A		<0.0002	
S-2-2-A		0.0002	
S-2-3-A		<0.0002	
S-2-6-A		<0.0002	
Basic solution			
S-2-1-B		<0.0002	
S-2-2-B		<0.0002	
S-2-3-B		<0.0002	
S-2-6-B		<0.0002	

TABLE 1-6. GAS CHROMATOGRAPHY ANALYSIS
RUN #2, SAMPLE S-2-3

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	0	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		64.1	
GC15			
GC16			
GC17			

TABLE 1-7. GAS CHROMATOGRAPHY ANALYSIS
RUN #2, SAMPLE S-2-4

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	0	
GC9	140-160	822.0	
GC10	160-180	219.0	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		2,000.0	
GC15			
GC16			
GC17			

TABLE 1-8. GAS CHROMATOGRAPHY ANALYSIS
RUN #2, SAMPLE S-2-5

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	16.6	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		5,323.0	
GC15			
GC16			
GC17			

TABLE 1-9. GAS CHROMATOGRAPHY ANALYSIS
RUN #2, SAMPLE S-2-6

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	0	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		241.4	
GC15			
GC16			
GC17			

TABLE 1-10. GAS CHROMATOGRAPHY ANALYSIS RUN #2, SAMPLE S-2-7

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	0	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		1,856.0	
GC15			
GC16			
GC17			

TABLE 1-11. GAS CHROMATOGRAPHY ANALYSIS RUN #2, SAMPLE S-2-1

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	4,518.0	
GC9	140-160	0	
GC10	160-180	0	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		17,642.0	
GC15			
GC16			
GC17			

TABLE 1-12. GAS CHROMATOGRAPHY ANALYSIS
RUN #2, SAMPLE S-2-2

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	0	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	0	
GC11	180-200	0	
GC12	200-220	0	
GC13		0	
GC14		35.0	
GC15			
GC16			
GC17			

LC fractionation for Fly Ash NBS Sample #1633 showed 0 throughout all categories.

PHYSICAL CHARACTERISTICS

The overflow bed, sludge, and the particulate samples (S-2-4-1, S-2-5, S-2-7-2, and S-2-7-3) were agglomerates of gray and sand colored materials. The smallest cluster, and some individual particles, were about 15μ in diameter. There were also traces of white and red materials.

S-2-7-2 contained some unusually large materials, which are described below:

Color	Shape	Size (μ)	Comments
White, opaque	Trapezoidal	150 × 220	Observed numerous parallel lines in particle, suggest crystalline material
Yellow	Rectangular	90 × 100 230 × 305	

This sample also contained a few long, narrow rod like objects, all about 500μ × 40μ.

S-2-7-3 contained traces of fibrous appearing material and bright, shiny, maybe metallic particles.

The bulk of particles in the emission samples S-2-5, S-2-6, and S-2-7 were uniform in character and comparable to one another.

TABLE 1-13.
LC FRACTIONATION

SAMPLE: S-2-1

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				
Recovered[d]		36.0* (51.0%)		8,969.1*

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg) sample
1		8.0		1,993.0
2		2.2		548.0
3		3.0		747.4
4		4.8		1,196.0
5		5.2		1,296.0
6		11.2		2,790.0
7		0.3		74.7

*Sum includes LC8 (1,300 μg; 324 μg/g) no longer included in Level 1 procedures.

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 1-14.
LC FRACTIONATION

SAMPLE: S-2-3

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				
Recovered[d]		1.3* (203%)		130.0*

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg) sample
1		0		0
2		0.3		30
3		0		0
4		0		0
5		0		0
6		0.3		30.0
7		0.5		50.0

*Sum includes LC8 (200 µg; 20 µg/g) no longer included in Level 1 procedures.

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 1-15.
LC FRACTIONATION

SAMPLE: S-2-4

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				
Recovered[d]		1.8* (246%)		3,747.0*

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg) sample
1		0		0
2		0		0
3		0		0
4		0.2		549.0
5		0.2		549.0
6		0.5		183.0
7		0.8		2,192.0

*Sum includes LC8 (100 µg; 274 µg/g) no longer included in Level 1 procedures.

---

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 1-16.
LC FRACTIONATION

SAMPLE: S-2-5

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				
Recovered[d]		10.75* (51.0%)		2,711.8*

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg) sample
1		1.6		416
2		0		0
3		1.8		454
4		1.1		277.4
5		1.1		277.4
6		3.0		757.0
7		0.4		101.0

*Sum includes LC8 (1,700 µg; 429 µg/g) no longer included in Level 1 procedures.

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 1-17.
LC FRACTIONATION

SAMPLE: S-2-6

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				
Recovered[d]		0.8* (84.2%)		203.3*

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg) sample
1		0		0
2		0.1		25.4
3		0		0
4		0.3		76.3
5		0		0
6		0.2		50.8
7		0.1		25.4

*Sum includes LC8 (100 μg; 25.4 μg/g) no longer included in Level 1 procedures.

---

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 1-18.
LC FRACTIONATION

SAMPLE: S-2-7

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m³, L, or kg)
Total Sample[b]				
Taken for LC[c]				
Recovered[d]		1.5* (152.0%)		2,812.0*

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m³, L, or kg) sample
1		0		0
2		0.4		750.0
3		0.2		375.0
4		0.1		187.0
5		0		0
6		0.8		1,500.0
7		0		0

*Sum includes LC8 no longer included in Level 1 procedures.

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

LC fractionation for Sample S-2-2 was "not conducted; sample size not adequate."

LC fractionation for Fly Ash Sample (NBS #1633) showed '0' throughout all categories.

TABLE 1-19.
IR REPORT

SAMPLE: S-2-6

Wave Number (cm^{-1})	Intensity	Assignment/Comments
250†	major	$CaSO_4 \cdot \frac{1}{2} H_2O$
175†	major	$CaSO_4 \cdot \frac{1}{2} H_2O$
120†	major	$CaSO_4 \cdot \frac{1}{2} H_2O$
410†	medium	Fe_3O_4
200†	medium	Fe_3O_4
320†	medium	$CaSO_4 \cdot 2H_2O$
1100-1190‡	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
725‡	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
670‡	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
610‡	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
595‡	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
800‡	low	SiO_2
780‡	low	SiO_2
460‡	low	SiO_2
410‡	low	Fe_2O_3

OTHER REMARKS:

*major >10%
medium 5-10%
low 1-5%
trace <1%

†Far-infrared spectral region.
‡Mid-infrared spectral region.

TABLE 1-20.
IR REPORT

SAMPLE: S-2-3

Wave Number (cm^{-1})	Intensity *	Assignment/Comments
1100-1190	major	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
725	major	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
670	major	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
610	major	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
1400	medium	$CaCO_3$ (vaterite)
875 (side peak		
850)	medium	$CaCO_3$ (vaterite)
740	medium	$CaCO_3$ (vaterite)
710	medium	$CaCO_3$ (vaterite)

OTHER REMARKS:

*major >10%
medium 5-10%
low 1-5%
trace <1%

Note: Mid-infrared spectra region.

TABLE 1-21.

IR REPORT

SAMPLE: S-2-4

Wave Number (cm^{-1})	Intensity *	Assignment/Comments
1400	medium	$CaCO_3$ (calcite)
875	medium	$CaCO_3$ (calcite)
715	medium	$CaCO_3$ (calcite)
1100-1190	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
725	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
670	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
610	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
595	medium	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
800	low	SiO_2 (crystalline)
780	low	SiO_2 (crystalline)

OTHER REMARKS:

*major >10%
medium 5-10%
low 1-5%
trace <1%

Note: Mid-infrared spectra region.

TABLE 1-22.

IR REPORT

SAMPLE: S-2-5

Wave Number (cm^{-1})	Intensity *	Assignment/Comments
1050 (broad)	major	SiO_2 (crystalline)
800	major	SiO_2 (crystalline)
780	major	SiO_2 (crystalline)
695	major	SiO_2 (crystalline)
460	major	SiO_2 (crystalline)

OTHER REMARKS:

*major >10%
medium 5-10%
low 1-5%
trace <1%

Note: Mid-infrared spectra region.

TABLE 1-23.
IR REPORT

SAMPLE: S-2-7-2 and S-2-7-3

Wave Number (cm^{-1})	Intensity	Assignment/Comments
1100 (broad)	medium	SiO_2
800	medium	SiO_2
780	medium	SiO_2
460	medium	SiO_2
1100-1190	not reported	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
725	not reported	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
670	not reported	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
610	not reported	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)
595	not reported	$CaSO_4 \cdot 2H_2O$ and $CaSO_4$ (anhydrous)

OTHER REMARKS:

*major >10%
medium 5-10%
low 1-5%
trace <1%

Note: Mid-infrared spectra region.

TABLE 1-24.
IR REPORT

SAMPLE: S-2-1, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbon	
NR	medium	aromatic hydrocarbon	
NR	minor	water	
NR	trace	ester	

IR REPORT

SAMPLE: S-2-2, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbon	
NR	minor	water	
NR	trace	ester	

NR = not reported.

TABLE 1-25.
IR REPORT

SAMPLE: S-2-3, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbon	
NR	medium	aromatic hydrocarbon	
NR	minor	water	
NR	trace	ester	

IR REPORT

SAMPLE: S-2-4, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbon	
NR	medium	aromatic hydrocarbon	
NR	minor	water	
NR	trace	ester	

NOTE: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in in the document.

NR = not reported.

TABLE 1-26.
IR REPORT

SAMPLE: S-2-5, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbon	
NR	medium	aromatic hydrocarbon	
NR	minor	ester	
NR	trace	water	

IR REPORT

SAMPLE: S-2-6, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbons	
NR	medium	aromatic hydrocarbons	
NR	minor	ester	
NR	trace	water	

NOTE: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-27.
IR REPORT

SAMPLE: S-2-7, >C13

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	major	aliphatic hydrocarbons	
NR	medium	aromatic hydrocarbons	
NR	minor	water	
NR	trace	ester	

IR REPORT

SAMPLE:

Wave Number (cm^{-1})	Intensity	Assignment	Comments

NOTE: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-28. IR REPORT

SAMPLE: S-2-1, LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC fraction
		number
NR	major	1 aliphatic hydrocarbon
NR	medium	aromatic hydrocarbon
NR	minor	water
NR	trace	ester
NR	major	2 aliphatic hydrocarbon
NR	medium	aromatic hydrocarbon
NR	minor	water
NR	trace	ester
NR	major	3 aromatic hydrocarbons
NR	medium	halogenated aromatic
NR	minor	water
NR	trace	ester
NR	major	4 ether
NR	medium	halogenated aromatic
NR	minor	water
NR	trace	ester
NR	major	5 phenol
NR	medium	halogenated aromatic
NR	minor	water
NR	trace	ester

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-29. IR REPORT

SAMPLE: S-2-1, LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC fraction
		number
NR	major	6 phenol
NR	medium	carboxylic acid
NR	minor	water
NR	trace	ketone
NR	major	7 carboxylic acid
NR	medium	phenol
NR	minor	water
NR	trace	ketone
NR	major	8 water
NR	medium	carboxylic acid
NR	minor	water
NR	trace	ketone

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-30. IR REPORT

SAMPLE: S-2-3, LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC
		fraction
NR		1 NR
NR	major	2 ester, phthalate
		3 no infrared activity
NR	trace	4 aliphatic hydrocarbon
NR	trace	5 aliphatic hydrocarbon
NR	major	6 acid, phthalate
NR	trace	7 aliphatic hydrocarbon
NR	major	8 water
NR	medium	carboxylic acid

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-31. IR REPORT

SAMPLE: S-2-4. LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC
		fraction
		1 NR
NR	major	2 aliphatic hydrocarbons
NR	medium	aromatic hydrocarbon
NR	major	3 aromatic hydrocarbon
NR	medium	aliphatic hydrocarbon
NR	trace	ester
NR	major	4 ester
NR	medium	halogenated aromatic
NR	trace	water
NR	major	5 phenol
NR	major	6 phenol
NR	medium	carboxylic acid
NR	major	7 carboxylic acid
NR	medium	water
NR	major	8 carboxylic acid
NR	medium	water

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-32. IR REPORT

SAMPLE: S-2-5, LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC
		fraction
		1 NR
NR	major	2 aromatic hydrocarbon
NR	medium	halogenated aromatic hydrocarbons
NR	major	3 aromatic hydrocarbon
NR	medium	ester
NR	minor	halogenated aromatic hydrocarbons
		4 NR
NR	major	5 aromatic hydrocarbon
NR	medium	halogenated aromatic hydrocarbons
NR	minor	ester
NR	trace	carboxylic acid
NR	major	6 carboxylic acid
NR	major	ester
NR	medium	water
NR	major	7 carboxylic acid
NR	medium	water
NR	major	8 water
NR	medium	carboxylic acid

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-33. IR REPORT

SAMPLE: S-2-6, LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC
		fraction
NR	major	1 aliphatic hydrocarbon
NR	medium	aromatic hydrocarbon
NR	major	2 aliphatic hydrocarbon
NR	medium	aromatic hydrocarbon
NR	medium	3 halogenated aromatic
NR	major	4 ester
NR	major	5 phenol
NR	medium	ester
NR	major	6 ester
NR	medium	phenol
NR	major	7 carboxylic acid
NR	medium	water
NR	minor	ester
NR	major	8 water
NR	medium	carboxylic acid
NR	minor	ester

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

TABLE 1-34. IR REPORT

SAMPLE: S-2-7, LC fractionation

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC
		fraction
NR	major	1 aliphatic hydrocarbon
NR	medium	aromatic hydrocarbon
NR	medium	2 aromatic hydrocarbon
NR	medium	3 aromatic hydrocarbon
NR	trace	4 ester
NR	trace	5 aliphatic hydrocarbon
NR	major	6 ester
NR	major	phthalate
		7 no infrared activity
		8 no infrared activity

OTHER REMARKS:

Note: Spectra for S-2-3, S-2-4, S-2-5, S-2-6, and S-2-7 were presented in the document.

NR = not reported.

LC fractionation not conducted on sample S-2-2.

TABLE 1-35

LRMS REPORT

SAMPLE: S-2-1

Major Categories

Intensity	Category	MW Range
NR	free sulfur,	NR
NR	trans-1-2-3 trimethyl-4 propenyl-naphthalene,	NR
NR	1,2-dimethyl-4-benzylbenzene,	NR
NR	2-methyl anthracene,	NR
NR	1-methylphenanthrene, triphenylbenzene,	NR
NR	1,2,4,5-tetraisopropylbenzene, and others	NR

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

Comments: very complex spectra of high molecular weight aliphatic and substituted aromatic compounds, all of which have not been identified.

NR = not reported.

TABLE 1-36

LRMS REPORT

SAMPLE: S-2-3

Major Categories

Intensity	Category	MW Range
NR	1-octadecene	NR
NR	1-heptadecene	NR
NR	1-hexadecene	NR
NR	1-dodecene	NR

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

Comments: very small sample residue with only a trace of hydrocarbons and a trace of phthalate ester.

NR = not reported.

TABLE 1-37

LRMS REPORT

SAMPLE: S-2-4

Major Categories

Intensity	Category	MW Range
NR	1-octadecene	NR
NR	1-hexadecene	NR

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

Comments: very small sample residue with only a trace of hydrocarbons and a trace of phthalate ester.

NR = not reported.

LRMS REPORT

TABLE 1-38

SAMPLE: S-2-5

Major Categories

Intensity	Category	MW Range
NR	2-phenyl naphthalene	NR
NR	1,6 diphenylpenta-1-4-diene-3-one	NR
NR	2-phenyl naphthalene	NR

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

Comments: small sample residue with hydrocarbons, phtalates, and a series of high molecular weight substituted aromatics.

NR = not reported.

TABLE 1-39

LRMS REPORT

SAMPLE: S-2-6

Major Categories

Intensity	Category	MW Range
NR	1-octadecene	NR

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

Comments: small sample residue with hydrocarbons, phthalates, and a trace of high molecular weight aromatics.

NR = not reported

LRMS REPORT

TABLE 1-40

SAMPLE: S-2-7

Major Categories

Intensity	Category	MW Range
NR	1-octadecene	NR

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

Comments: small residue with hydrocarbons, phthalates, and a trace of high molecular weight aromatics.

NR = not reported.

The document includes:

1. Atomic Absorption Calibration Curves for the following elements:
    - Lithium
    - Silver
    - Chromium
    - Magnesium
    - Mercury
    - Zinc
    - Cadmium
    - Beryllium
    - Lead
    - Vanadium
    - Silicon
    - Strontium (range 0.0-1.0 ppm)
    - Strontium (range 0.0-10.0 ppm)
    - Copper
    - Nickel
    - Platinum
2. FTIR Spectral Scans for the following samples:
    - S-2-3
    - S-2-4
    - S-2-5
    - S-2-6
    - S-2-3 corrected for mineral oil
    - S-2-4 corrected for mineral oil
    - S-2-5 corrected for mineral oil
    - S-2-6 corrected for mineral oil
    - S-2-7-2 corrected for mineral oil
    - S-2-7-3 corrected for mineral oil
3. ESCA Scans for the following samples:
    - S-2-5
    - S-2-6
    - S-2-7-2
    - S-2-7-3
4. SEM-EDX Scans for the following flyash samples:
    - S-2-3
    - S-2-4
    - S-2-5
    - S-2-6
    - S-2-7-2

LEVEL 2

Table 2-3. Summary of Required Level 2 Analysis

		MEG Category Number Requiring Level 2 Analyses by LC Fraction									
	FBC Sample	LC 1	LC 2	LC 3	LC 4	LC 5	LC 6	LC 7	LC 8	Inorganics	Level II Leachate Studies
Assessment of Individual FBC Samples	S-2-3, Overflow Bed Material >325 Mesh	26	2,16,21,22	16,21,22			8,10,13,19,23	8,10,19,20	8	Li, Na, K, Mg, Sr, Ba, Aℓ, Ge, Sn, Pb, P, As, S, Se, Ti, V, Cr, Fe, Rh, Ni, Pt, Cu, Ag, Cd, Hg	2, 8, 10, 13, 16, 19, 20, 21, 22, 23, 26, Li, Na, K, Mg, Sr, Ba, Aℓ, Ge, Sn, Pb, P, As, S, Cℓ, Br, F, I, Se, Tℓ, V, Cr, Fe, Rh, Ni, Pt, Cu, Ag, Cd, Hg,
	S-2-4 Bed Material Ash - 325 Mesh	26	21,22	21,22						Na, K, Mg, Ca, Si, Pb, As, S, Cℓ, Cr, Fe, Rh, Cu	21, 22, 26, Na, K, Mg, Cr, Si, Pb, As, S, Cℓ, Cr, Fe, Rh, Cu
	S-2-5 Sludge Sample	26	2,16,21,22	16,21,22			10,23	10,20		Li, Na, K, Mg, Ca, Ba, Aℓ, Sn, Pb, N, As, S, Se, Cℓ, Ti, V, Cr, Fe, Rh, Ni, Cu, Cd, Hg	
	S-2-6, >27μ Particulate	26	2,16,21,22	16,21,22			10,23	10,20		Li, Na, K, Be, Mg, Ca, Sr, Ba, Aℓ, C, Si, Pb, N, P, As, Se, S, Cℓ, Ti, Zr, V, Cr, Mn, Fe, Co, Rh, Ni, Pt, Cu, Ag, Cd, Hg	
	S-2-7, < 27μ Particulate	26	2,16,21,22	16,21,22			10,19,23	10,19,20	8	Na, K, Ca, Aℓ, Si, P, As, S, Ti, V, Cr, Fe, Ni, Hg	
	S-2-9, FLUE* Gas Sample (Level 2 sample not available)	26	2,16,21	16,21	17	12,17	10,13,19,23	10,19,20	8		
Assessment of Total Emission Data (Table 1-2)	S-2-5, S-2-6 and S-2-7	26	2,15,16,22	16,21,22	25		10,13,23	10,19,20		Li, Na, K, Be, Mg, Ca, Sr, Ba, Aℓ, Ti, Si, Pb, N, P, As, Y, Ti, Zr, Y, Cr, Mn, Fe, Co, Ph, Ni, Cd, U, Th	

*Level 2 Sampling Effort Required

Table 3-1. Tabulation of Thermal Gravimetric Data

Sample Number	Sample Description	Temperature of Activity (°C)	Precentage Weight Loss (% w/w)
S-2-1	Illinois Coal No. 6	100	4.0
		150	7.0
		200	9.0
		300	9.0
		350	Onset of Organic Fraction Decomposition
S-2-2	Grove Limestone	100	0
		150	0
		> 200	0
S-2-3	Overflow Bed Material >325 Mesh	100	0
		150	0
		200	0
		300	0
		350	0
		400	Onset of Organic Fraction Decomposition
S-2-4	Overflow Bed Material - 325 Mesh	100	2.0
		150	2.2
		200	2.2
		300	2.2
		350	2.2
		400	Onset of Organic Fraction Decomposition
S-2-5	Sludge	100	4.5
		150	4.5
		200	4.5
		300	4.5
		350	4.5
		400	Onset of Organic Fraction Decomposition

Table 3-1. Tabulation of Thermal Gravimetric Data (Continued)

Sample Number	Sample Description	Temperature of Activity (°C)	Precentage Weight Loss (% w/w)
S-2-6	Particulates > 27 μ	100	0
		150	0
		200	0
		300	0
		350	0
		400	Onset of Organic Fraction Decomposition
S-2-7	Particulates < 27 μ	100	1.0
		150	1.0
		200	1.0
		300	1.0
		350	1.0
		400	Onset of Organic Fraction Decomposition

Table 3-7. ICPOES Results on Leachate Samples

	Sample Code	Element (mg/ℓ)																				
		Fe	K	Mg	Mn	Na	P	Se	Al	B	Ba	Be	Ca	Cu	Ag	As	Cd	Co	Cr	Mo	Ni	Zr
Acidic Leachates	S-2-1-A	45.97	0.8	2.06	0.16	N.D.	N.D.	N.D.	1.11	2.9	N.D.	N.D.	20.0	0.007	N.D.	N.D.	N.D.	N.D.	0.009	N.D.	N.D.	N.D.
	S-2-2A	0.082	0.7	0.547	N.D.	N.D.	N.D.	N.D.	0.64	1.5	0.46	N.D.	10.04	0.004	N.D.	0.2	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
	S-2-3-A	0.802	4.5	1.36	N.D.	N.D.	N.D.	N.D.	7.14	20.3	N.D.	N.D.	985.0	0.012	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
	S-2-6-A	0.197	12.3	1.32	0.59	1.0	N.D.	N.D.	15.1	15.76	N.D.	N.D.	277.0	0.014	N.D.	0.3	N.D.	N.D.	0.018	N.D.	N.D.	0.007
Basic Leachates	S-2-1-B	58.3	2.2	0.72	0.10	75.0	N.D.	N.D.	0.94	1.90	N.D.	N.D.	6.86	0.019	0.012	N.D.	N.D.	0.12	0.014	0.20	N.D.	N.D.
	S-2-2-B	N.D.	4.0	0.08	N.D.	14.0	N.D.	N.D.	0.26	6.49	N.D.	N.D.	15.76	0.01	0.013	N.D.	N.D.	0.11	0.007	0.44	N.D.	0.016
	S-2-3-B	N.D.	2.7	N.D.	N.D.	17.0	N.D.	N.D.	0.21	10.5	N.D.	N.D.	266.0	0.002	N.D.	N.D.	N.D.	N.D.	N.D.	0.06	0.17	N.D.
	S-2-6-B	22.9	9.9	4.28	0.803	125.0	N.D.	N.D.	2.4	9.9	N.D.	N.D.	34.0	0.002	N.D.	N.D.	N.D.	N.D.	N.D.	0.17	N.D.	N.D.

N.D. Not Detected

Table 3-10. ESCA Results

Sample Code	Sample Area	Elements Identified	Atom Percent	Oxidation States Derived
S-2-5	Surface	Fe_{2p}	3	Fe^3
		O_{1s}	64	O^{-2}
		Ca_{2p}	4	Ca^2
		C_{1s}	-	C
		Na_{1s}	0.2	Na^1
		S_{2p}	1	S^6
		Si_{2s}	18	Si^2
		Al_{2s}	10	Al^3
	Interior 100Å	Fe_{2p}	3	Fe^3
		O_{1s}	54	O^{-2}
		Ca_{2p}	0.6	Ca^2
		C_{1s}	-	C
		Na_{1s}	0.03	Na^1
		S_{2p}	-	S^6
		Si_{2s}	21	Si^2
		Al_{2s}	18	Al^3
S-2-6	Surface	Fe_{2p}	2	Fe^3
		O_{1s}	62	O^{-2}
		Ca_{2p}	4	Ca^2
		C_{1s}	-	C
		S_{2p}	2	S^6
		Si_{2s}	22	Si^2
		Al_{2s}	8	Al^3

Table 3-10. ESCA Results (Continued)

Sample Code	Sample Area	Elements Identified	Atom Percent	Oxidation States Derived
S-2-7	Surface	Fe_{2p}	1	Fe^3
		O_{1s}	61	O^{-2}
		Ca_{2p}	5	Ca^2
		C_{1s}	-	C
		Na_{1s}	2	Na^1
		S_{2p}	7	S^6
		Si_{2s}	13	Si^2
		Al_{2s}	12	Al^3
S-2-7	Interior 100Å	Fe_{2p}	1	Fe^3
		O_{1s}^{-2}	53	O^{-2}
		Ca_{2p}	10	Ca^2
		C_{1s}	-	
				C
		Na_{1s}	1	Na^1
		S_{2p}	5	$SO_4^=$, S^- ratio 6:4
		Si_{2s}	16	Si^2
		Al_{2s}	15	Al^3
	Interior 200Å	Fe_{2p}	2	Fe^3
		O_{1s}	53	O^{-2}
		Ca_{2p}	9	Ca^2
		C_{1s}	-	C
		Na_{1s}	1	Na^1
		S_{2p}	3	$SO_4^=$, S^- ratio 5.5:4.5
		Si_{2s}	17	Si^2
		Al_{2s}	14	Al^3

Table 3-11. XRD Results

Sample Code	Determined d-spacings	Compound Identified	Literature d-spacings	Relative Intensity
S-2-5	2.52	Fe_2O_3	2.51	Strong
	3.68		3.66	
	2.69		2.69	
	1.48		1.48	
	1.84		1.84	
	1.69		1.69	
	3.36	SiO_2	3.34	Medium
	4.26		4.26	
	1.82		1.82	
	1.54		1.54	
	2.46		2.46	
	2.26		2.28	
	2.84	$CaSO_4$	2.85	Medium
	2.28		2.33	
	3.06		3.05	
S-2-6	3.37	SiO_2	3.34	Strong
	4.27		4.26	
	1.82		1.82	
	1.54		1.54	
	2.47		2.46	
	2.29		2.28	
	2.52	Fe_2O_3	2.51	Medium
	3.64		3.66	
	2.70		2.69	
	1.49		1.48	
	1.70		1.69	
	2.85	$CaSO_4$	2.85	Medium
	2.30		2.33	
	3.04		3.05	
	2.85	CaS	2.85	Low
	2.09		2.01	
	1.61		1.64	
	2.41	CaO	2.41	Low
	1.74		1.70	
	2.70		2.78	

Table 3-11. XRD Results (Continued)

Sample Code	Determined d-spacings	Compound Identified	Literature d-spacings	Relative Intensity
S-2-7	3.34	SiO_2	3.34	Strong
	4.26		4.26	
	1.82		1.82	
	2.46		2.46	
	2.28		2.28	
	2.84	$CaSO_4$	2.85	Strong
	3.67		3.66	
	2.69		2.69	
	1.69		1.69	
	2.84	CaS	2.85	Medium
	2.03		2.01	
	1.64		1.64	
	2.51	Fe_2O_3	2.51	Low
	3.67		3.66	
	2.69		2.69	
	1.69		1.69	

Compounds, Elements and Ions Identified:

Li, Li^+, $Li_2\ CO_3$

Na^+ Na_2O

K^+

Be^{++}, BeO, $BeO \cdot Al_2O_3 \cdot SiO_2$

Mg^{++}, MgO, $MgSO_4$, $MgCO_3$, $MgCO_3 \cdot CaCO_3$

Ca++, $CaCO_3$, $CaSO_4$, $MgCO_3 \cdot CaCO_3$

Sr^{++}, $SrSO_4$

Ba, $BaCO_2$, $BaSO_4$

Al^{+3}, $Al_2O_3 \cdot 3H_2O$, Al_2O_3

Tl

Table 3-12. EPMA Identified Elements

Sample Code	Elements Detected	Relative Abundance*
S-2-3	Calcium	Major
	Sulfur	Medium
	Oxygen	Medium
	Silicon	Medium
	Iron	Low
	Potassium	Low
S-2-4	Calcium	Major
	Sulfur	Medium
	Oxygen	Medium
	Silicon	Medium
	Iron	Low
	Potassium	Low
	Chlorine	Trace
	Magnesium	Trace
	Aluminum	Trace
S-2-5	Calcium	Major
	Sulfur	Medium
	Oxygen	Major
	Silicon	Major
	Iron	Medium
	Potassium	Medium
	Aluminum	Low
S-2-6	Calcium	Medium
	Sulfur	Medium
	Oxygen	Medium
	Silicon	Major
	Iron	Low
	Potassium	Medium
S-2-7	Calcium	Major
	Sulfur	Major
	Oxygen	Major
	Silicon	Major
	Iron	Medium
	Potassium	Medium
	Aluminum	Low
	Magnesium	Low
	Chlorine	Low
	Titanium	Low

*	
Major	>10%
Medium	5-10%
Low	1-5%
Trace	<1%

Table 3-13. Level 2 Data on FBC Emission Samples

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/l HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m^3 (ppm) µg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
27. LITHIUM	Li	2.2×10	3.3×10^2	3.8×10^2	7.0×10^{-1}	7.5×10^{-1}	6.9×10^2		Exceeds Mate				
	Li^+	2.2×10	3.3×10^2	3.8×10^2									
	LiF (as Li)	2.2×10	3.3×10^2	3.8×10^2									
	Li_2CO_3 (as Li)	2.2×10	3.3×10^2	3.8×10^2									
	LiH	2.5×10	3.8×10^2	N									
28. SODIUM	Na^+	5.3×10^4	8.0×10^5	N	1.6×10^3	N	5.4×10^5		Exceeds Mate - See Note 1				
	NaOH	2.0×10^3	3.0×10^4	N	6.0×10	N							
29. POTASSIUM	KOH	2.0×10^3	3.0×10^4	N	6.0×10	N							
	K	N	N	N	N	N	6.7×10^4		See Note 1				
	K^+ (as K)	N	N	2.3×10^4	N	4.6×10							
30. RUBIDIUM	Rb^{+1}	1.21×10^5	1.82×10^6	N	3.64×10^3	N							
31. CESIUM	CS^{+1}	8.19×10^4	1.23×10^6	N	2.46×10^3	N							
32. BERYLLIUM	Be	2.0	3.0×10	5.5×10	6.0×10^{-2}	1.1×10^{-1}	N.D.						
	Be^{++}	2.0	3.0×10	5.5×10	6.0×10^{-2}	1.1×10^{-1}	N.D.		See Note 1				
	BeO (as Be)						N.D.						
	$BeO \cdot Al_2O_3 \cdot SiO_2$ (as Be)	2.0	3.0×10	5.5×10	6.0×10^{-2}	1.1×10^{-1}	N.D.						
33. MAGNESIUM	Magnesium, Mg	6.0×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2	7.34×10^4		Exceeds Mate				
	Magnesium Ion, Mg^{++}	6.01×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2	3.7×10^3		See Note 1				
	Magnesium Oxide, MgO	1.01×10^4	1.5×10^5	1.0×10^5	3.0×10^2	2.0×10^2		Present Based on Compound Data					
	Magnesium Fluoride, MgF_2 (as Mg)	6.0×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2	N.D.						
	Magnesium Sulfate, $MgSO_4$ (as Mg)	6.0×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2		Present Based on Compound Data					
	Magnesite, $MgCO_3$ (as Mg)	6.0×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2	N.D.						
	Dolomite, $MgCO_3 \cdot CaCO_3$ (as Mg)	6.0×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2	N.D.						
	Asbestos (as Mg)	6.0×10^3	9.0×10^4	8.7×10^4	1.8×10^2	1.7×10^2	N.D.						
34. CALCIUM	Calcium Ion, Ca^{++}	1.6×10^4	2.4×10^5	1.6×10^4	4.8×10^2	3.2×10	9.5×10^5		Exceeds Mate - See Note 1				
	Calcium Fluoride, CaF_2	N	N	N	N	N	N.D.						
	Calcium Carbonate, $CaCO_3$	N	N	N	N	N	Present Based on Compound Data						
	Calcium Sulfate, $CaSO_4$	N	N	N	N	N	Present Based on Compound Data						
	Dolomite, $MgCO_3 \cdot CaCO_3$	N	N	N	N	N	N.D.						

*Summation of S-2-5, S-2-6 and S-2-7 N.D. Not Detected

1. Based on Level 2 leachate study of sample S-2-6.

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPEC-TATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
35. STRONTIUM	Strontium	3.1×10^3	4.6×10^4	N	9.2×10	N	1.4×10^4		Exceeds Mate				
	Strontium Ion, Sr^{++} (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
	Strontium Fluoride, SrF_2 (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N	N.D.						
	Strontium Sulfate, $SrSO_4$ (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N	Present Based on Compound Data						
36. BARIUM	Barium, Ba	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Ion, Ba^{++} (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0	N.D.						
	Barium Sulfide, BaS (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Thiocarbonate, $BaCS_3$ (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Fluoride, BaF_2 (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Carbonate, $BaCO_3$ (as Ba)	5.0×10^2	5.0×10^3	8.5×10^3	1.0×10	5.0							
	Barium Sulfate, $BaSO_4$ (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
37. BORON	Boron, B	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10	N.R.						
	Borate, BO_3 (as B)	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10							
	Metaborate, BO_2^- (as B)	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10							
	Boron Oxide, B_2O_3	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
38. ALUMINUM	Aluminum, Al	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.01							
	Aluminum Ion, Al^{+++}	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	N	5.2×10^4		Exceeds Mate - See Note 1				
	Bauxite, $Al_2O_3 \cdot 3H_2O$ (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Hydrated Aluminum Silicate (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Alums $[M\,Al\,(SO_4)_2] \cdot (H_2O)_x$ (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Aluminum Oxide, Al_2O_3	1.0×10^4	1.5×10^5	N	3.0×10^2	N	Present Based on Compound Data						
39. GALLIUM	Gallium, Ga	5.0×10^3	7.4×10^4	N	1.5×10^2	N	N.R.						
	Elemental Species, Ga	5.0×10^3	7.4×10^4	N	1.5×10^2	N							
	Gallous, Ga^{+1} (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N							

*Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Detected
N.R. Not Required on Level 2

1. Based on Level 2 leachate study of sample S-2-6.

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m^3 (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	SAMPLE* μg/m^3 (ppm) μg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Gallic, Ga^{+3} (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N	N.R.						
	Gallium Sesquioxide, Ga_2O_3 (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N							
40. INDIUM	Indium, In	1.0×10^2	1.5×10^3	N	3.0	N	N.R.						
	Indium Ion, In^{+3}	1.0×10^2	1.5×10^3	N	3.0	N							
41. THALLIUM	Thallium, Tl	1.0×10^2	1.5×10^3	N	3.0	N	N.D.						
	Thallous, Tl^{+1}	1.0×10^2	1.5×10^3	N	3.0	N							
	Thallic, Tl^{+3}	1.0×10^2	1.5×10^3	N	3.0	N							
42. CARBON	Elemental Carbon	3.5×10^3	5.3×10^4	N	1.6×10^2	N							
	Coal	N	N	N	N	N							
	Carbide, C-	N	N	N	N	N							
	Carbonate, CO_3^{-2}	N	N	N	N	N	Present Based on Compound Data						
	Bicarbonate, HCO_3	N	N	N	N	N							
	Carbonyl, CO=	N	N	N	N	N							
	Carbon Monoxide	4.0×10^3 (35)	6.0×10^5	6.0×10	N/A	N/A							
	Carbon Dioxide	9.0×10^6 (5000)	N	N	N/A	N/A							
43. SILICON	Silane, SiH_4	7.0×10^2	1.1×10^4	N	N	2.1×10	N.R.						
	Silicon, Si	1.0×10^4	1.5×10^5	N	3.0×10^2	N	1.3×10^7		Exceeds Mate				
	Orthosilicate, SiO_4^{-2}	N	N	N	N	N							
	Metasilicate, SiO_3^{-2}	N	N	N	N	N							
	Silicon Dioxide, SiO_2	1.0×10^4	1.5×10^5	N	3.0×10^2	N	Present Based on Compound Data						
	Silicon Disulfide, SiS_2	N	N	N	N	N							
	Silicon Carbide, SiC	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
44. GERMANIUM	Germanium, Ge	5.6×10^2	8.4×10^3	N	1.7×10	N	N.R.						
	Germanous, Ge^{+2} (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanic, Ge^{+4} (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanous Sulfide, GeS (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanic Sulfice, GeS_2 (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germane, GeH_4 (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanium Oxide, GeO_2 (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Detected
N.R. Not Required on Level 2

1. Based on Level 2 leachate study of sample S-2-6.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE* $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
45. TIN	Tin Oxide, SnO_2	1.0×10^4	1.5×10^5	N	3.0	N	N.R.						
	Tin, Sn	N	N	N	N	N							
	Stannous, Sn^{+2}	N	N	N	N	N							
	Stannic, Sn^{+4}	N	N	N	N	N							
46. LEAD	Lead, Pb	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	3.3×10^3		Exceeds Mate				
	Elemental Lead, Pb	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Plumbous, Pb^{+2}	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Plumbic, Pb^{+4} (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Lead Monoxide, PbO (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Lead Sulfate, $PbSO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	Present	Based on Compound Data					
	Lead Sulfate, Pbs (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Lead Carbonate, $PbCO_3$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	Present	Based on Compound Data					
	Lead Phosphate, $Pb_3(PO_4)_2$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Lead Chromate, $PbCrO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Lead Molybdate, $PbMoO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Lead Arsenate, $PbHAsO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
47. NITROGEN	Hydrazine	1.5×10^2 (.1)	2.3	N	4.5	N	N.R.						
	Alkali Cyanides, NaCN, KCN	5.0×10^3	5.0×10^2	2.5×10	1.0	5.0×10^{-2}							
	Nitric Acid, HNO_3	5.0×10^3	7.5×10^4	4.5×10^2	1.5×10^3	9.0×10^{-1}							
	Nitrogen Oxides, N_2O, NO_2, N_2O_4, N_2O_3, N_2O_5	9.0×10^3	1.4×10^5	N	N/A	N/A							
	Hydrogen Cyanide, HCN	1.1×10^4 (10)	5.0×10^2	2.5×10	1.0	5.0×10^{-2}							
	Ammonia, NH_3	1.8×10^4 (25)	2.5×10^3	5.0×10	5.0	1.0×10^{-1}							
	Cyanogen, C_2N_2	2.0×10^4	1.0×10^3	2.5×10	2.0	5.0×10^{-2}							
	Nitride, N=	N	N	N	N	N							
	Nitrate, NO_3^-	N	N	N	N	N	N.D.	Based on Compound Data					
	Nitrite, NO_2^-	N	N	N	N	N	N.D.	Based on Compound Data					
	Ammonium, NH_4^+	N	N	N	N	N	N.D.	Based on Compound Data					

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-6.

N.D. Not Detected
N.R. Not Required on Level 2

1. Based on Level 2 leachate study of sample S-2-6.

Table 3-13. Level 2 Data on FBC Emission Samples (continued)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m^3 (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
48. PHOSPHORUS	Phosphorus, P	1.0×10^2	1.5×10^4	5.0×10^{-1}	3.0×10	1.0×10^{-3}	N.D.			See Note 1			
	Phosphite, PO_3^{-3} (as P)	1.0×10^2	1.5×10^4	5.0×10^{-1}	3.0×10	1.0×10^{-3}	N.D.			See Note 1			
	Biphosphate, $H_2PO_4^-$ (as P)	1.0×10^2	1.5×10^4	5.0×10^{-1}	3.0×10	1.0×10^{-3}							
	Phosphine, PH_3	4.0×10^2 (0.3)	6.0×10^3	N	N/A	N/A							
	Phosphoric Acid, H_3PO_4	1.0×10^3	1.5×10^4	4.5×10^3	3.0×10	9.0							
	Phosphorus Pentasulfide	1.0×10^3	1.5×10^4	N	3.0×10	N							
	Phosphate, PO_4^{-3}	N	N	N	N	N	N.D.			See Note 1			
49. ARSENIC	Arsenic, As	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	5.0×10^{-1}			See Note 1			
	Metallic Arsenic	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	5.0×10^{-1}			See Note 1			
	Arsenous, As^{+3}	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	5.0×10^{-1}			See Note 1			
	Arsenic, As^{+5}	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	Present Based on Compound Data						
	Arsenate, AsO_4^{-3} (as As)	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	Present Based on Compound Data						
	Arsenite, AsO_3^{-3} (as As)	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenide, As^{-3} (as As)	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsine, AsH_3	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenic Trioxide, As_2O_3	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	Present Based on Compound Data						
50. ANTIMONY	Antimony Trioxide, Sb_2O_3	5.0×10^1	7.5×10^2	2.0×10^2 (as Sb)	1.5×10	4.0×10^{-1} (as Sb)	N.R.						
	Antimony Metal, Sb	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimonous, (stibnous) Sb^{+3}	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimonic (stibnic) Sb^{+5}	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Stibine, SbH_3 (as Sb)	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimonous Sulfide, Sb_2S_3	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimony, Sb	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
51. BISMUTH	Bismuth, Bi	4.1×10^2	6.1×10^3	N	1.2×10^1	N	N.R.						
	Elemental Bismuth, Bi	4.1×10^2	6.1×10^3	N	1.2×10^1	N							
	Bismuthous, Bi^{+3} (as Bi)	4.1×10^2	6.1×10^3	N	1.2×10^1	N							
	Bismuthic, Bi^{+5} (as Bi)	4.1×10^2	6.1×10^3	N	1.2×10^1	N							

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GS/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7.

1. Based on Level 2 leachate study of sample S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m³ (ppm) µg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
52. OXYGEN	Ozone, O_3	2.0×10^2 (0.1)	N/A	N/A	N/A	N/A							
53. SULFUR	Rhombic Sulfur, S_8	N	N	N	N	N	N.R.						
	Sulfide, S^{-2}	N	N	N	N	N							
	Sulfate, SO_4^{-2}	N	N	N	N	N	Present	Based on	Compound Data				
	Sulfite, SO_3^{-2}	N	N	N	N	N	Present	Based on	Compound Data				
	Thiocyanate, SCN^-	N	N	N	N	N							
	Sulfur Trioxide, SO_3	N	N .	N	N	N							
	Sulfuric Acid, H_2SO_4	1.0×10^3	1.5×10^4	4.5×10^2	3.0×10^1	9.0×10^2							
	Sulfur Dioxides, SO_2	1.3×10^4	2.0×10^5	N	4.0×10^2	N							
	Hydrogen Sulfide, H_2S	1.5×10^4 (10)	2.3×10^4	1.0×10^1	N/A	N/A							
	Carbon Disulfide, CS_2	6.0×10^4 (20)	9.0×10^5	1.0×10^4	N/A	N/A							
	Carbonyl Sulfide, COS	4.4×10^5	N/A	N/A	N/A	N/A							
54. SELENIUM	Selenium, Se	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}	N.R.						
	Elemental Selenium, Se	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}							
	Selenide, Se^{-2}	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}							
	Selenites, SeO_3^{-2} (as Se)	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}							
	Selenates, SeO_4^{-2} (as Se)	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}							
	Hydrogen Selenide, H_2Se	2.0×10^2 (.05)	5.0×10^1 (as Se)	2.5×10^1 (as Se)	1.0×10^{-1} (as Se)	5.0×10^{-2} (as Se)							
	Carbon Diselenide, CSe_2 (as Se)	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}							
	Selenium Dioxide, SeO_2 (as Se)	2.0×10^2	5.0×10^1	2.5×10^1	1.0×10^{-1}	5.0×10^{-2}							
55. TELLURIUM	Tellurium, Te	1.0×10^2	1.5×10^3	N	3.0×10	N	N.R.						
	Telluride, Te^{-2}	1.0×10^2	1.5×10^3	N	3.0×10	N							
	Tellurite, TeO_3^{-2} (as Te)	1.0×10^2	1.5×10^3	N	3.0×10	N							
	Tellurate, TeO_4 (as Te)	1.0×10^2	1.5×10^3	N	3.0×10	N							
56. FLUORIDE	Fluoride Ion, F^-	2.5×10^3	3.8×10^4	N	7.5×10^1	N	N.R.						
	Hydrogen Fluoride, HF	2.0×10^3	3.0×10^4	N	N/A	N/							

TABLE KEY:

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   3. UNKNOWN

   A. AAS
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   C. WET CHEMICAL
   D. ESCA
   E. GS/MS
2. EXPECTED TEST SUCCESS
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

* Summation of S-2-5, S-2-6 and S-2-7.

[1] Based on Level 2 leachate study of sample S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m³ (ppm) µg/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
57. CHLORINE	Chloride Ion, Cl^-	N	1.3×10^6	N	2.6×10^3	N	N.R.						
	Hypochlorite, ClO^-	N	N	N	N	N							
	Chlorite, ClO_2^-	N	N	N	N	N							
	Chlorate, ClO_3	N	N	N	N	N							
	Chlorine Dioxide, ClO_2	N	N	N	N	N							
	Carbohyl Chloride (phosgene), $COCl_2$	4.0×10^2	6.0×10^3	N	N/A	N/A							
	Hydrogen Chloride, HCl	7.0×10^3	1.1×10^5	N	N/A	N/A							
58. BROMINE	Bromide Ion, Br^-	N	N	N	N	N	N.R.						
	Bromide Ion, Br^-	N	N	N	N	N							
	Hydrogen Bromide, HBr	1.0×10^4	1.5×10^5	N	N/A	N/A							
59. IODINE	Iodide Ion, I^-	N	N	N	N	N	N.R.						
60. SCANDIUM	Scandium, Sc	5.3×10^4	8.0×10	N	1.6×10^{-2}	N	N.R.						
	Scandium Ion, Sc^{+3}	5.3×10^4	8.0×10	N	1.6×10^{-2}	N							
61. YTTRIUM	Yttrium Ion, Y^{+3}	1.0×10^3	1.5×10^4	N	3.0×10^1	N	N.R.						
62. TITANIUM	Titanium, Ti	6.0×10^3	9.0×10^4	8.2×10^2 (as $Ti[SO_4]_2$)	1.8×10^2	1.6×10							
	Titanous, Ti^{+3} (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
	Titanic, Ti^{+4} (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
	Titanium Dioxide, TiO_2 (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10	N.D.						
63. ZIRCONIUM	Zirconium Ion, Zr^{+4}	5.0×10^3	7.5×10^4	N	1.5×10^1	N	2.0x10	Does Not Exceed Mate					
	Zirconium Dioxide, ZrO_2 (as Zr)	5.0×10^3	7.5×10^4	N	1.5×10^1	N							
64. HAFNIUM	Hafnium Ion, Hf^{+4}	5.0×10^2	7.5×10^4	N	1.5×10	N	N.R.						
65. VANADIUM	Vanadium, V	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	2.6×10^3	Exceeds Mate					
	Elemental Vanadium, V	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadic, V^{+3} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadyl, Vo^{+2} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Orthovanadate, VO_4^{-4} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	Present Based on Compound Data						

TABLE KEY:

1. TEST METHOD
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   3. UNKNOWN

   A. AAS
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   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

* Summation of S-2-5, S-2-6 and S-2-7.

1. Based on Level 2 leachate study of S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE* $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPECTATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
	Metavanadate, VO_3^- (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadylic, VO^{+3} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Monoxide, VO (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Trioxide, V_2O_3 (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	Present	Based on Compound Data					
	Vanadium Tetraoxide, V_2O_4, (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	Present	Based on Compound Data					
	Vanadium Pentoxide, V_2O_5 (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	Present	Based on Compound Data					
	Vanadium Carbide, VC (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Monosulfide, VS (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Nitride, VN (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadyl Sulfate, $VOSO_4 \cdot 5H_2O$ (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	Present	Based on Compound Data					
66. NIOBIUM	Niobus, Nb^{+3}	2.2×10^4	3.3×10^5	N	6.5×10^2	N	N.R.						
	Niobic, Nb^{+5}	2.2×10^4	3.3×10^5	N	6.5×10^2	N							
	Niobium Oxides, NbO, Nb_2O_5 (as Nb)	2.2×10^4	3.3×10^3	N	6.5×10^2	N							
67. TANTALUM	Tantalum Ion, Ta^{+5}	5.0×10^3	7.5×10^4	N	1.5×10^2	N	N.R.						
68. CHROMIUM	Chromium, Cr	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	8.34×10^3	Exceeds Mate					
	Chromous, Cr^{+2} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	3.9×10	Exceeds Mate - See Note 1					
	Chromic, Cr^{+3} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	3.9×10	Exceeds Mate - See Note 1					
	Chromates, CrO_4^{-2} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	Present	Based on Compound Data					
	Chromites, $Cr_2O_4^{-2}$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	Present	Based on Compound Data					
	Bichromates, $Cr_2O_7^{-2}$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromium Carbonyl, $Cr(CO)_6$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromium Sulfide, Cr_2S_3	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	Present	Based on Compound Data					
	Chromic Oxide, Cr_2O_3 (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	Present	Based on Compound Data					
	Chromite Mineral, FeO Cr_2O_3 (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							

TABLE KEY

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   3. UNKNOWN

   A. AAS
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   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

* Summation of S-2-5, S-2-6 and S-2-7.

1. Based on Level 2 leachate study of S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m^3 (ppm)^2 µg/l.	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPECTATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
	Hydrous Chromium Phosphate, $CrPO_4$ XH_2O (as Cr)	1.0 x 10	2.5 x 10^2	2.5 x 10^2	5.0 x 10^{-1}	5.0 x 10^{-1}							
	Iron Chromate, $FeCrO_4$ (as Cr)	1.0 x 10	2.5 x 10^2	2.5 x 10^2	5.0 x 10^{-1}	5.0 x 10^{-1}							
69. MOLYBDEN	Molybdenum, Mo	5.0 x 10^3	7.5 x 10^4	7.0 x 10^3	1.5 x 10^2	1.4 x 10^1	N.R.						
	Molybdenous, Mo^{+2}	5.0 x 10^3	7.5 x 10^4	7.0 x 10^3	1.5 x 10^2	1.4 x 10^1							
	Molybdic, Mo^{+3}	5.0 x 10^3	7.5 x 10^4	7.0 x 10^3	1.5 x 10^2	1.4 x 10^1							
	Molybdate, MoO_4^{-2} (as Mo)	5.0 x 10^3	7.5 x 10^4	7.0 x 10^3	1.5 x 10^2	1.4 x 10^1							
	Molybdenum Sulfide, MoS_2 (as Mo)	5.0 x 10^3	7.5 x 10^4	7.0 x 10^3	1.5 x 10^2	1.4 x 10^1							
	Molybdenum Trioxide, MoO_3 (as Mo)	5.0 x 10^3	7.5 x 10^4	7.0 x 10^3	1.5 x 10^2	1.4 x 10^1							
70. TUNGSTEN	Tungsten, W	1.0 x 10^3	1.5 x 10^4	N	3.0 x 10^1	N	N.R.						
	Tungsten Ions, W^{+2}, W^{+4}, W^{+5}, W^{+6}, WO_4^{-2}	N	N	N	N	N							
	Tungsten Disulfide, WS_2 (as W)	1.0 x 10^3	1.5 x 10^4	N	3.0 x 10^1	N							
	Wolframite Mineral, $FeWO_4 \cdot MnWO_4$ (as W)	1.0 x 10^3	1.5 x 10^4	N	3.0 x 10^1	N							
71. MANGANESE	Manganese, Mn	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganous, Mn^{+2}	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}	1.3x10^2	Does Not Exceed Mate					
	Manganic, Mn^{+3}	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}	1.3x10^2						
	Permanganate, MnO_4^- (as Mn)	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganous Oxide, MnO (as Mn)	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganese Dioxide, MnO_2 (as Mn)	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganese Carbonate, $McCO_3$ (as Mn)	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganous Sulfate, $MnSO_4$ (as Mn)	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganese Sulfide, MnS_2 (as Mn)	5.0 x 10^3	2.5 x 10^2	1.0 x 10^2	5.0 x 10^{-1}	2.0 x 10^{-1}							
72. IRON	Iron Carbonyls, $Fe(CO)_5$, $Fe(CO)_9$, $FE_3(CO)_{12}$	7.0 x 10^2	1.1 x 10^4	N	2.1 x 10^1	N							
	Ferrous, Fe^{+2}	1.0 x 10^3	1.5 x 10^3	2.5 x 10^2	3.0 x 10	5.0 x 10^{-1}	5.6x10^2	Does Not Exceed Mate					
	Ferric, Fe^{+3}	1.0 x 10^3	1.5 x 10^3	2.5 x 10^2	3.0 x 10	5.0 x 10^{-1}	5.6x10^2	Does Not Exceed Mate					
	Ferrous Oxide, FeO	5.0 x 10^3	7.5 x 10^4	N	1.5 x 10^2	N	N.D.						

TABLE KEY:

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   1. STANDARD
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   A. AAS
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   D. ESCA
   E. GC/MS

2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN

3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH

4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

* Summation of -2-5, S-2-6 and S-2-7.

1. Based on Level 2 leachate study of sample S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m³ (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	SAMPLE* μg/m³ (ppm) μg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y-YES N-NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Magnetite, $FeO \cdot Fe_2O_3$	9.3×10^{3}	6.2×10^{3}	N	3.8×10^{1}	N							
	Ferrocyanide, $Fe(CN)_6^{-4}$	N	N	N	N	N							
	Ferricyanide, $Fe(CN)_6^{-3}$	N	N	N	N	N							
	Ferric Oxide, Fe_2O_3	N	N	N	N	N	Present Based on Compound Data						
	Ferric Hydroxide (hydrated) $Fe_2O_3 \cdot XH_2O$	N	N	N	N	N							
	Iron Sulfides, FeS, Fe_2S_3	N	N	N	N	N							
	Pyrite, FeS_2	N	N	$>1.0 \times 10^{5}$	N	2.0×10^{2}							
	Potassium Iron Silicate, $KFeSi_2O_6$	N	N	N	N	N							
73. RUTHENIUM	Ruthenium Ion, Ru^{+3}	N	N	N	N	N	N.R.						
74. COBALT	Cobalt, Co	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobaltous, Co^{+2}	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}	N.D.						
	Cobaltic, Co^{+3}	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}	N.D.						
	Cobaltous Carbonate, hydrated, $CoCO_3 \cdot H_2O$ (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobalt Carbide, Co_3C (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobalt Sulfides, CoS, Co_2S_3 (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobalt Arsenic Sulfide, CoAsS (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobalt Arsenide, $CoAs_2$ (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobalt Carbonyl, $Co(CO)_4$ (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobaltous Oxide, CoO (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
	Cobaltous Hydroxide, $Co(OH)_2$ (as Co)	5.0×10^{1}	7.5×10^{2}	2.5×10^{2}	1.5×10	5.0×10^{-1}							
75. RHODIUM	Rhodium Ion, Rh^{+3}	1.0×10	1.5×10^{1}	N	3.0×10^{-2}	N	N.D.						
76. NICKEL	Nickelous, Ni^{+2}	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}	N.D.	See Note 1					
	Nickelic, Ni^{+3}	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}	N.D.	See Note 1					
	Nickelous Sulfide, NiS (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Arsenide, NiAs (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							

TABLE KEY

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

* Summation of S-2-5, S-2-6 and S-2-7.

[1] Based on Level 2 leachate study of sample S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE* µg/m^3 (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Nickel Oxide, NiO (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Antimonide, NiSb (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Arsenic Sulfide, NiAsS (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Carbonyl, $Ni(CO)_4$	4.3×10^{1}	6.5×10^{2}	1.0×10^{1} (as Ni)	1.0×10	2.0×10^{-3}							
77. PLATINUM	Elemental Platinum, Pt	2.0×10	3.0×10^{1}	N	6.0×10^{-2}	N	N.R.						
78. COPPER	Copper	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Cuprous, Cu^{+}	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}	4.6x10	Does Not Exceed Mate					
	Cupric, Cu^{+2}	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}	4.6x10	Does Not Exceed Mate					
	Copper Fluoride, CuF_2 (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Oxides, CuO, Cu_2O (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-5}							
	Copper Sulfate, $CuSO_4$ (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Sulfides, CuS, Cu_2S (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Carbonate, $CuCO_3$ (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Malachite Mineral, $CuCO_3 \cdot Cu(OH)_2$ (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Chalcopyrite Mineral, $CuFeS_2$	N	N	N	N	N							
79. SILVER	Silver, Ag	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}	3.9×10^{2}		Exceeds Mate				
	Silver Ion, Ag^{+} (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Chloride, AgCl (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Cyanide, AgCN (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Sulfide, Ag_2S (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}	Present Based on Compound Data						
80. GOLD	Elemental Gold	N	N	N	N	N	N.R.						
81. ZINC	Zinc, Zn	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}	6.6×10^{3}		Exceeds Mate				
	Elemental Zinc, Zn	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}							
	Zinc Ion, Zn^{+2}	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}							
	Zinc Oxide, ZnO (as Zn)	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}	Present Based on Compound Data						

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

* Summation of S-2-5, S-2-6 and S-2-7.

1. Based on Level 2 leachate study of sample S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

Table 3-13. Level 2 Data on FBC Emission Samples (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE* $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Zinc Sulfate, $ZnSO_4$ (as Zn)	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}	Present	Based on	Compound Data				
	Zinc Sulfide, ZnS (as Zn)	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}	Present	Based on	Compound Data				
82. CADMIUM	Cadmium, Cd	1.0×10^1	5.0×10^1	1.0×10	1.0×10^{-1}	2.0×10^{-3}	5.0		Does not exceed mate				
	Elemental Cadmium, Cd	1.0×10^1	5.0×10^1	1.0×10	1.0×10^{-1}	2.0×10^{-3}							
	Cadmium Ion, Cd^{+2}	1.0×10^1	5.0×10^1	1.0×10	1.0×10^{-1}	2.0×10^{-3}							
	Cadmium Sulfide, CdS (as Cd)	1.0×10^1	5.0×10^1	1.0×10	1.0×10^{-1}	2.0×10^{-3}							
	Cadmium Oxide, CdO (as Cd)	1.0×10^1	5.0×10^1	1.0×10	1.0×10^{-1}	2.0×10^{-3}							
83. MERCURY	Mercury, Hg	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}	9.3×10^2		Exceeds Mate				
	Elemental Mercury, Hg	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercurous, Hg_2^{++}	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercuric, Hg^{++}	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercuric Sulfide, HgS	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercuric Chloride, $HgCl_2$	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
84. CERIUM	Dysprosium, Dy (Dy^{+3})	9.3×10^3	2.3×10^5	N	4.6×10^2	N	N.R.						
	Cerium, Ce (Ce^{+3}, Ce^{+4}, Ce_2O_3)	3.7×10^4	5.5×10^5	N	1.1×10^3	N							
	Praseodymium, Pr (Pr^{+3})	5.1×10^4	7.7×10^5	N	1.5×10^3	N							
	Samarium, Sm (Sm^{+3})	5.3×10^4	7.9×10^5	N	1.6×10^3	N							
	Lanthanum, La	1.1×10^5	1.7×10^6	N	3.4×10^3	N							
	Neodymium, Nd (Nd^{+3})	N	N	N	N	N							
85. URANIUM	Uranium, U (U^{+6})	9.0×10	6.0×10^4	5.0×10^2	1.2×102	1.0×10	N.D.						
86. THORIUM	Thorium, Th (Th^{+4})	4.2×10^2	6.3×10^3	N	1.3×10	N	N.D.						

* Summation of S-2-5, S-2-6 and S-2-7.

1. Based on Level 2 leachate study of sample S-2-6.

N.D. Not Detected.

N.R. Not Required on Level 2.

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials

Level 2 Leachate Studies of Overflow Bed Materials*

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPEC-TATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
27. LITHIUM	Li	2.2×10	3.3×10^{2}	3.8×10^{2}	7.0×10^{-1}	7.5×10^{-1}	5.8×10^{2}		Exceeds Mate				
	Li^{+}	2.2×10	3.3×10^{2}	3.8×10^{2}									
	LiF (as Li)	2.2×10	3.3×10^{2}	3.8×10^{2}									
	Li_2CO_3 (as Li)	2.2×10	3.3×10^{2}	3.8×10^{2}									
	LiH	2.5×10	3.8×10^{2}	N									
28. SODIUM	Na^{+}	5.3×10^{4}	8.0×10^{5}	N	1.6×10^{3}	N	1.7×10^{4}		Does Not Exceed Mate				
	NaOH	2.0×10^{3}	3.0×10^{4}	N	6.0×10	N							
29. POTASSIUM	KOH	2.0×10^{3}	3.0×10^{4}	N	6.0×10	N	7.2×10^{3}		Does Not Exceed Mate				
	K	N	N	N	N	N							
	K^{+} (as K)	N	N	2.3×10^{4}	N	4.6×10							
30. RUBIDIUM	Rb^{+1}	1.21×10^{5}	1.82×10^{6}	N	3.64×10^{3}	N	N.D.						
31. CESIUM	Cs^{+1}	8.19×10^{4}	1.23×10^{6}	N	2.46×10^{3}	N	N.D.						
32. BERYLLIUM	Be	2.0	3.0×10	5.5×10	6.0×10^{-2}	1.1×10^{-1}	N.D.						
	Be^{++}	2.0	3.0×10	5.5×10	6.0×10^{-2}	1.1×10^{-1}							
	BeO (as Be)												
	$BeO \cdot Al_2O_3 \cdot SiO_2$ (as Be)	2.0	3.0×10	5.5×10	6.0×10^{-2}	1.1×10^{-1}							
33. MAGNESIUM	Magnesium, Mg	6.0×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}	1.4×3		Does Not Exceed Mate				
	Magnesium Ion, Mg^{++}	6.01×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}							
	Magnesium Oxide, MgO	1.01×10^{4}	1.5×10^{5}	1.0×10^{5}	3.0×10^{2}	2.0×10^{2}							
	Magnesium Fluoride, MgF_2 (as Mg)	6.0×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}							
	Magnesium Sulfate, $MgSO_4$ (as Mg)	6.0×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}							
	Magnesite, $MgCO_3$ (as Mg)	6.0×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}							
	Dolomite, $MgCO_3 \cdot CaCO_3$ (as Mg)	6.0×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}							
	Asbestos (as Mg)	6.0×10^{3}	9.0×10^{4}	8.7×10^{4}	1.8×10^{2}	1.7×10^{2}							
34. CALCIUM	Calcium Ion, Ca^{++}	1.6×10^{4}	2.4×10^{5}	1.6×10^{4}	4.8×10^{2}	3.2×10	1.3×10^{6}		Exceeds Mate				
	Calcium Fluoride, CaF_2	N	N	N	N	N							
	Calcium Carbonate, $CaCO_3$	N	N	N	N	N							
	Calcium Sulfate, $CaSO_4$	N	N	N	N	N							
	Dolomite, $MgCO_3 \cdot CaCO_3$	N	N	N	N	N							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPECTATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
36. STRONTIUM	Strontium	3.1×10^3	4.6×10^4	N	9.2×10	N	3.9×10^2	Does Not Exceed Mate					
	Strontium Ion, Sr^{++} (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
	Strontium Fluoride, SrF_2 (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
	Strontium Sulfate, $SrSO_4$ (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
36. BARIUM	Barium, Ba	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0	N.D.						
	Barium Ion, Ba^{++} (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Sulfide, BaS (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Thio-carbonate, $BaCS_3$ (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Fluoride, BaF_2 (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Carbonate, $BaCO_3$ (as Ba)	5.0×10^2	5.0×10^3	8.5×10^3	1.0×10	5.0							
	Barium Sulfate, $BaSO_4$ (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
37. BORON	Boron, B	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10	3.1×10^4	Does Not Exceed Mate					
	Borate, BO_3 (as B)	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10							
	Metaborate, Bo_2- (as B)	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10							
	Boron Oxide, B_2O_3	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
38. ALUMINUM	Aluminum, Al	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.01	7.4×10^3	Does Not Exceed Mate					
	Aluminum Ion, Al^{+++}	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	N							
	Bauxite, $Al_2O_3 \cdot 3H_2O$ (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Hydrated Aluminum Silicate (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Alums $[M\,Al\,(SO_4)_2] \cdot (H_2O)_x$ (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Aluminum Oxide, Al_2O_3	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
39. GALLIUM	Gallium, Ga	5.0×10^3	7.4×10^4	N	1.5×10^2	N	N.D.						
	Elemental Species, Ga	5.0×10^3	7.4×10^4	N	1.5×10^2	N							
	Gallous, Ga^{+1} (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO $\frac{SAMPLE}{MATE}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Gallic, Ga^{+3} (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N							
	Gallium Sesquioxide, Ga_2O_3 (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N							
40. INDIUM	Indium, In	1.0×10^2	1.5×10^3	N	3.0	N	N.D.						
	Indium Ion, In^{+3}	1.0×10^2	1.5×10^3	N	3.0	N							
41. THALLIUM	Thallium, Tl	1.0×10^2	1.5×10^3	N	3.0	N	N.D.						
	Thallous, Tl^{+1}	1.0×10^2	1.5×10^3	N	3.0	N							
	Thallic, Tl^{+3}	1.0×10^2	1.5×10^3	N	3.0	N							
42. CARBON	Elemental Carbon	3.5×10^3	5.3×10^4	N	1.6×10^2	N	N.D.						
	Coal	N	N	N	N	N							
	Carbide, C-	N	N	N	N	N							
	Carbonate, CO_3^{-2}	N	N	N	N	N							
	Bicarbonate, HCO_3	N	N	N	N	N							
	Carbonyl, CO=	N	N	N	N	N							
	Carbon Monoxide	4.0×10^3 (35)	6.0×10^5	6.0×10	N/A	N/A							
	Carbon Dioxide	9.0×10^6 (5000)	N	N	N/A	N/A							
43. SILICON	Silane, SiH_4	7.0×10^2	1.1×10^4	N	N	2.1×10	2.6×10^5		Exceeds Mate				
	Silicon, Si	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
	Orthosilicate, SiO_4^{-2}	N	N	N	N	N							
	Metasilicate, SiO_3^{-2}	N	N	N	N	N							
	Silicon Dioxide, SiO_2	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
	Silicon Disulfide, SiS_2	N	N	N	N	N							
	Silicon Carbide, SiC	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
44. GERMANIUM	Germanium, Ge	5.6×10^2	8.4×10^3	N	1.7×10	N	N.D.						
	Germanous, Ge^{+2} (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanic, Ge^{+4} (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanous Sulfide, GeS (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanic Sulfice, GeS_2 (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germane, GeH_4 (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							
	Germanium Oxide, GeO_2 (as Ge)	5.6×10^2	8.4×10^3	N	1.7×10	N							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
45. TIN	Tin Oxide, SnO_2	1.0×10^4	1.5×10^5	N	3.0	N	N.D.						
	Tin, Sn	N	N	N	N	N							
	Stannous, Sn^{+2}	N	N	N	N	N							
	Stannic, Sn^{+4}	N	N	N	N	N							
46. LEAD	Lead, Pb	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	2.3×10^2		Does Not Exceed Mate				
	Elemental Lead, Pb	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Plumbous, Pb^{+2}	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Plumbic, Pb^{+4} (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Monoxide, PbO (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Sulfate, $PbSO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Sulfate, Pbs (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Carbonate, $PbCO_3$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Phosphate, $Pb_3(PO_4)_2$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Chromate, $PbCrO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Molybdate, $PbMoO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Arsenate, $PbHAsO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
47. NITROGEN	Hydrazine	1.5×10^2 (.1)	2.3	N	4.5	N	N.D.						
	Alkali Cyanides, NaCN, KCN	5.0×10^3	5.0×10^2	2.5×10	1.0	5.0×10^{-2}							
	Nitric Acid, HNO_3	5.0×10^3	7.5×10^4	4.5×10^2	1.5×10^3	9.0×10^{-1}							
	Nitrogen Oxides, N_2O, NO_2, N_2O_4, N_2O_3, N_2O_5	9.0×10^3	1.4×10^5	N	N/A	N/A							
	Hydrogen Cyanide, HCN	1.1×10^4 (10)	5.0×10^2	2.5×10	1.0	5.0×10^{-2}							
	Ammonia, NH_3	1.8×10^4 (25)	2.5×10^3	5.0×10	5.0	1.0×10^{-1}							
	Cyanogen, C_2N_2	2.0×10^4	1.0×10^3	2.5×10	.2.0	5.0×10^{-2}							
	Nitride, N=	N	N	N	N	N							
	Nitrate, NO_3^-	N	N	N	N	N							
	Nitrite, NO_2^-	N	N	N	N	N							
	Ammonium, NH_4^+	N	N	N	N	N							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
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   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS

2. EXPECTED TEST SUCCESS
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR μg/m³ (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	SAMPLE μg/m³ (ppm) μg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
48. PHOSPHORUS	Phosphorus, P	1.0×10^2	1.5×10^4	5.0×10^{-1}	3.0×10	1.0×10^{-3}	N.D.						
	Phosphite, PO_3^{-3} (as P)	1.0×10^2	1.5×10^4	5.0×10^{-1}	3.0×10	1.0×10^{-3}							
	Biphosphate, $H_2PO_4^-$ (as P)	1.0×10^2	1.5×10^4	5.0×10^{-1}	3.0×10	1.0×10^{-3}							
	Phosphine, PH_3	4.0×10^2 (0.3)	6.0×10^3	N	N/A	N/A							
	Phosphoric Acid, H_3PO_4	1.0×10^3	1.5×10^4	4.5×10^3	3.0×10	9.0							
	Phosphorus Pentasulfide	1.0×10^3	1.5×10^4	N	3.0×10	N							
	Phosphate, PO_4^{-3}	N	N	N	N	N							
49. ARSENIC	Arsenic, As	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Metallic Arsenic	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Arsenous, As^{+3}	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenic, As^{+5}	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenate, AsO_4^{-3} (as As)	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenite, AsO_3^{-3} (as As)	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenide, As^{-3} (as As)	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsine, AsH_3	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
	Arsenic Trioxide, As_2O_3	2.0×10	2.5×10^2	5.0×10^1	5.0×10^{-1}	1.0×10^{-1}							
50. ANTIMONY	Antimony Trioxide, Sb_2O_3	5.0×10^1	7.5×10^2	2.0×10^2 (as Sb)	1.5×10	4.0×10^{-1} (as Sb)							
	Antimony Metal, Sb	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}	N.D.						
	Antimonous, (stibnous) Sb^{+3}	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimonic (stibnic) Sb^{+5}	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Stibine, SbH_3 (as Sb)	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimonous Sulfide, Sb_2S_3	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
	Antimony, Sb	5.0×10^2	7.5×10^3	2.0×10^2	1.5×10^1	4.0×10^{-1}							
51. BISMUTH	Bismuth, Bi	4.1×10^2	6.1×10^3	N	1.2×10^1	N							
	Elemental Bismuth, Bi	4.1×10^2	6.1×10^3	N	1.2×10^1	N	N.D.						
	Bismuthous, Bi^{+3} (as Bi)	4.1×10^2	6.1×10^3	N	1.2×10^1	N							
	Bismuthic, Bi^{+5} (as Bi)	4.1×10^2	6.1×10^3	N	1.2×10^1	N							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GS/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m^3 (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPEC-TATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
52. OXYGEN	Ozone, O_3	2.0×10^{2} (0.1)	N/A	N/A	N/A	N/A	N.D.						
53. SULFUR	Rhombic Sulfur, S_8	N	N	N	N	N	N.D.						
	Sulfide, S^{-2}	N	N	N	N	N							
	Sulfate, SO_4^{-2}	N	N	N	N	N							
	Sulfite, SO_3^{-2}	N	N	N	N	N							
	Thiocyanate, SCN^-	N	N	N	N	N							
	Sulfur Trioxide, SO_3	N	N	N	N	N							
	Sulfuric Acid, H_2SO_4	1.0×10^{3}	1.5×10^{4}	4.5×10^{2}	3.0×10^{1}	9.0×10^{2}							
	Sulfur Dioxides, SO_2	1.3×10^{4}	2.0×10^{5}	N	4.0×10^{2}	N							
	Hydrogen Sulfide, H_2S	1.5×10^{4} (10)	2.3×10^{4}	1.0×10^{1}	N/A	N/A							
	Carbon Disulfide, CS_2	6.0×10^{4} (20)	9.0×10^{5}	1.0×10^{4}	N/A	N/A							
	Carbonyl Sulfide, COS	4.4×10^{5}	N/A	N/A	N/A	N/A							
54. SELENIUM	Selenium, Se	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}	N.D.						
	Elemental Selenium, Se	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenide, Se^{-2}	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenites, SeO_3^{-2} (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenates, SeO_4^{-2} (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Hydrogen Selenide, H_2Se	2.0×10^{2} (.05)	5.0×10^{1} (as Se)	2.5×10^{1} (as Se)	1.0×10^{-1} (as Se)	5.0×10^{-2} (as Se)							
	Carbon Diselenide, CSe_2 (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenium Dioxide, SeO_2 (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
55. TELLURIUM	Tellurium, Te	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N	N.D.						
	Telluride, Te^{-2}	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N							
	Tellurite, TeO_3^{-2} (as Te)	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N							
	Tellurate, TeO_4 (as Te)	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N							
56. FLUORIDE	Fluoride Ion, F^-	2.5×10^{3}	3.8×10^{4}	N	7.5×10^{1}	N	N.D.						
	Hydrogen Fluoride, HF	2.0×10^{3}	3.0×10^{4}	N	N/A	N/							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
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   D. ESCA
   E. GS/MS
2. EXPECTED TEST SUCCESS
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
57. CHLORINE	Chloride Ion, Cl^-	N	1.3×10^6	N	2.6×10^3	N	N.D.						
	Hypochlorite, ClO^-	N	N	N	N	N							
	Chlorite, ClO_2^-	N	N	N	N	N							
	Chlorate, ClO_3	N	N	N	N	N							
	Chlorine Dioxide, ClO_2	N	N	N	N	N							
	Carbonyl Chloride (phosgene), $COCl_2$	4.0×10^2	6.0×10^3	N	N/A	N/A							
	Hydrogen Chloride, HCl	7.0×10^3	1.1×10^5	N	N/A	N/A							
58. BROMINE	Bromide Ion, Br^-	N	N	N	N	N	N.D.						
	Bromide Ion, Br^-	N	N	N	N	N							
	Hydrogen Bromide, HBr	1.0×10^4	1.5×10^5	N	N/A	N/A							
59. IODINE	Iodide Ion, I^-	N	N	N	N	N	N.D.						
60. SCANDIUM	Scandium, Sc	5.3×10^4	8.0×10	N	1.6×10^{-2}	N	N.D.						
	Scandium Ion, Sc^{+3}	5.3×10^4	8.0×10	N	1.6×10^{-2}	N							
61. YTTRIUM	Yttrium Ion, Y^{+3}	1.0×10^3	1.5×10^4	N	3.0×10^1	N	N.D.						
62. TITANIUM	Titanium, Ti	6.0×10^3	9.0×10^4	8.2×10^2 (as $Ti[SO_4]_2$)	1.8×10^2	1.6×10	N.D.						
	Titanous, Ti^{+3} (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
	Titanic, Ti^{+4} (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
	Titanium Dioxide, TiO_2 (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
63. ZIRCONIUM	Zirconium Ion, Zr^{+4}.	5.0×10^3	7.5×10^4	N	1.5×10^1	N	N.D.						
	Zirconium Dioxide, ZrO_2 (as Zr)	5.0×10^3	7.5×10^4	N	1.5×10^1	N							
64. HAFNIUM	Hafnium Ion, Hf^{+4}	5.0×10^2	7.5×10^4	N	1.5×10	N	N.D.						
65. VANADIUM	Vanadium, V	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	N.D.						
	Elemental Vanadium, V	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadic, V^{+3} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadyl, VO^{+2} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Orthovanadate, VO_4^{-4} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected.

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR μg/m^3 (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	SAMPLE μg/m^3 (ppm) μg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPECTATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
	Metavanadate, VO_3^- (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadylic, VO^{+3} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Monoxide, VO (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Trioxide, V_2O_3 (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Tetraoxide, V_2O_4, (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Pentoxide, V_2O_5 (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Carbide, VC (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Monosulfide, VS (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Nitride, VN (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadyl Sulfate, $VOSO_4 \cdot 5H_2O$ (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
66. NIOBIUM	Niobus, Nb^{+3}	2.2×10^4	3.3×10^5	N	6.5×10^2	N	N.D.						
	Niobic, Nb^{+5}	2.2×10^4	3.3×10^5	N	6.5×10^2	N							
	Niobium Oxides, NbO, Nb_2O_5 (as Nb)	2.2×10^4	3.3×10^3	N	6.5×10^2	N							
67. TANTALUM	Tantalum Ion, Ta^{+5}	5.0×10^3	7.5×10^4	N	1.5×10^2	N	N.D.						
68. CHROMIUM	Chromium, Cr	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	N.D.						
	Chromous, Cr^{+2} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromic, Cr^{+3} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromates, CrO_4^{-2} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromites, $Cr_2O_4^{-2}$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Dichromates, $Cr_2O_7^{-2}$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromium Carbonyl, $Cr(CO)_6$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromium Sulfide, Cr_2S_3	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromic Oxide, Cr_2O_3 (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromite Mineral, FeO Cr_2O_3 (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS

2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN

3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH

4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm)² µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPECTATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
	Hydrous Chromium Phosphate, $CrPO_4$ XH_2O (as Cr)	1.0 x 10	2.5 x 10^{2}	2.5 x 10^{2}	5.0 x 10^{-1}	5.0 x 10^{-1}							
	Iron Chromate, $FeCrO_4$ (as Cr)	1.0 x 10	2.5 x 10^{2}	2.5 x 10^{2}	5.0 x 10^{-1}	5.0 x 10^{-1}							
69. MOLYBDEN	Molybdenum, Mo	5.0 x 10^{3}	7.5 x 10^{4}	7.0 x 10^{3}	1.5 x 10^{2}	1.4 x 10^{1}	6.0 x 10		Does Not Exceed Mate				
	Molybdenous, Mo^{+2}	5.0 x 10^{3}	7.5 x 10^{4}	7.0 x 10^{3}	1.5 x 10^{2}	1.4 x 10^{1}							
	Molybdic, Mo^{+3}	5.0 x 10^{3}	7.5 x 10^{4}	7.0 x 10^{3}	1.5 x 10^{2}	1.4 x 10^{1}							
	Molybdate, MoO_4^{-2} (as Mo)	5.0 x 10^{3}	7.5 x 10^{4}	7.0 x 10^{3}	1.5 x 10^{2}	1.4 x 10^{1}							
	Molybdenum Sulfide, MoS_2 (as Mo)	5.0 x 10^{3}	7.5 x 10^{4}	7.0 x 10^{3}	1.5 x 10^{2}	1.4 x 10^{1}							
	Molybdenum Trioxide, MoO_3 (as Mo)	5.0 x 10^{3}	7.5 x 10^{4}	7.0 x 10^{3}	1.5 x 10^{2}	1.4 x 10^{1}							
70. TUNGSTEN	Tungsten, W	1.0 x 10^{3}	1.5 x 10^{4}	N	3.0 x 10^{1}	N	N.D.						
	Tungsten Ions, W^{+2}, W^{+4}, W^{+5}, W^{+6}, WO_4^{-2}	N	N	N	N	N							
	Tungsten Disulfide, WS_2 (as W)	1.0 x 10^{3}	1.5 x 10^{4}	N	3.0 x 10^{1}	N							
	Wolframite Mineral, $FeWO_4 \cdot MnWO_4$ (as W)	1.0 x 10^{3}	1.5 x 10^{4}	N	3.0 x 10^{1}	N							
71. MANGANESE	Manganese, Mn	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}	N.D.						
	Manganous, Mn^{+2}	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganic, Mn^{+3}	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Permanganate, MnO_4^- (as Mn)	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganous Oxide, MnO (as Mn)	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganese Dioxide, MnO_2 (as Mn)	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganese Carbonate, $McCO_3$ (as Mn)	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganous Sulfate, $MnSO_4$ (as Mn)	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
	Manganese Sulfide, MnS_2 (as Mn)	5.0 x 10^{3}	2.5 x 10^{2}	1.0 x 10^{2}	5.0 x 10^{-1}	2.0 x 10^{-1}							
72. IRON	Iron Carbonyls, $Fe(CO)_5$, $Fe(CO)_9$, $FE_3(CO)_{12}$	7.0 x 10^{2}	1.1 x 10^{4}	N	2.1 x 10^{1}	N	8.0 x 10^{2}		Does Not Exceed Mate				
	Ferrous, Fe^{+2}	1.0 x 10^{3}	1.5 x 10^{3}	2.5 x 10^{2}	3.0 x 10	5.0 x-10^{-1}							
	Ferric, Fe^{+3}	1.0 x 10^{3}	1.5 x 10^{3}	2.5 x 10^{2}	3.0 x 10	5.0 x 10^{-1}							
	Ferrous Oxide, FeO	5.0 x 10^{3}	7.5 x 10^{4}	N	1.5 x 10^{2}	N							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
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   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

CATEGORY	COMPOUND	Level 2 Leachate Studies of Overflow Bed Material* MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Magnetite, $FeO \cdot Fe_2O_3$	9.3×10^3	6.2×10^3	N	3.8×10^1	N							
	Ferrocyanide, $Fe(CN)_6^{-4}$	N	N	N	N	N							
	Ferricyanide, $Fe(CN)_6^{-3}$	N	N	N	N	N							
	Ferric Oxide, Fe_2O_3	N	N	N	N	N							
	Ferric Hydroxide (hydrated) $Fe_2O_3 \cdot XH_2O$	N	N	N	N	N							
	Iron Sulfides, FeS, Fe_2S_3	N	N	N	N	N							
	Pyrite, FeS_2	N	N	$>1.0 \times 10^5$	N	2.0×10^2							
	Potassium Iron Silicate, $KFeSi_2O_6$	N	N	N	N	N							
73. RUTHENIUM	Ruthenium Ion, Ru^{+3}	N	N	N	N	N	N.D.						
74. COBALT	Cobalt, Co	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}	N.D.						
	Cobaltous, Co^{+2}	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltic, Co^{+3}	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltous Carbonate, hydrated, $CoCO_3 \cdot H_2O$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Carbide, Co_3C (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Sulfides, CoS, Co_2S_3 (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Arsenic Sulfide, CoAsS (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Arsenide, $CoAs_2$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Carbonyl, $Co(CO)_4$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltous Oxide, CoO (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltous Hydroxide, $Co(OH)_2$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
75. RHODIUM	Rhodium Ion, Rh^{+3}	1.0×10	1.5×10^1	N	3.0×10^{-2}	N	N.D.						
76. NICKEL	Nickelous, Ni^{+2}	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}	1.7×10^2	Does Not Exceed Mate					
	Nickelic, Ni^{+3}	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickelous Sulfide, NiS (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Arsenide, NiAs (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							

*Only sample, S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Nickel Oxide, NiO (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Antimonide, NiSb (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Arsenic Sulfide, NiAsS (as Ni)	1.5×10^{1}	2.3×10^{2}	1.0×10^{1}	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Carbonyl, $Ni(CO)_4$	4.3×10^{1}	6.5×10^{2}	1.0×10^{1} (as Ni)	1.0×10	2.0×10^{-3}							
77. PLATINUM	Elemental Platinum, Pt	2.0×10	3.0×10^{1}	N	6.0×10^{-2}	N	N.D.						
78. COPPER	Copper	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}	1.4×10		Does Not Exceed Mate				
	Cuprous, Cu^{+}	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Cupric, Cu^{+2}	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Fluoride, CuF_2 (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Oxides, CuO, Cu_2O (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-5}							
	Copper Sulfate, $CuSO_4$ (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Sulfides, CuS, Cu_2S (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Copper Carbonate, $CuCO_3$ (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Malachite Mineral, $CuCO_3 \cdot Cu(OH)_2$ (as Cu)	2.0×10^{2}	5.0×10^{3}	5.0×10^{1}	1.0×10^{1}	1.0×10^{-1}							
	Chalcopyrite Mineral, $CuFeS_2$	N	N	N	N	N							
79. SILVER	Silver, Ag	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}	N.D.						
	Silver Ion, Ag^{+} (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Chloride, AgCl (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Cyanide, AgCN (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Sulfide, Ag_2S (as Ag)	1.0×10^{1}	2.5×10^{2}	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
80. GOLD	Elemental Gold	N	N	N	N	N	N.D.						
81. ZINC	Zinc, Zn	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}	2.2×10^{2}		Does Not Exceed Mate				
	Elemental Zinc, Zn	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}							
	Zinc Ion, Zn^{+2}	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}							
	Zinc Oxide, ZnO (as Zn)	4.0×10^{3}	2.5×10^{4}	1.0×10^{2}	5.0×10^{1}	2.0×10^{-1}							

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
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   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 3-14. Level 2 Leachate Studies of Overflow Bed Materials (Continued)

Level 2 Leachate Studies of Overflow Bed Material*

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Zinc Sulfate, $ZnSO_4$ (as Zn)	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}							
	Zinc Sulfide, ZnS (as Zn)	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}							
82. CADMIUM	Cadmium, Cd	1.0×10^1	5.0×10^1	1.0 x 10	1.0×10^{-1}	2.0×10^{-3}	N.D.						
	Elemental Cadmium, Cd	1.0×10^1	5.0×10^1	1.0 x 10	1.0×10^{-1}	2.0×10^{-3}							
	Cadmium Ion, Cd^{+2}	1.0×10^1	5.0×10^1	1.0 x 10	1.0×10^{-1}	2.0×10^{-3}							
	Cadmium Sulfide, CdS (as Cd)	1.0×10^1	5.0×10^1	1.0 x 10	1.0×10^{-1}	2.0×10^{-3}							
	Cadmium Oxide, CdO (as Cd)	1.0×10^1	5.0×10^1	1.0 x 10	1.0×10^{-1}	2.0×10^{-3}							
83. MERCURY	Mercury, Hg	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}	N.D.						
	Elemental Mercury, Hg	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercurous, Hg_2^{++}	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercuric, Hg^{++}	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercuric Sulfide, HgS	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
	Mercuric Chloride, $HgCl_2$	5.0×10^1	1.0×10^1	2.5×10^2	2.0×10^{-2}	5.0×10^{-1}							
84. CERIUM	Dysprosium, Dy (Dy^{+3})	9.3×10^3	2.3×10^5	N	4.6×10^2	N	N.D.						
	Cerium, Ce (Ce^{+3}, Ce^{+4}, Ce_2O_3)	3.7×10^4	5.5×10^5	N	1.1×10^3	N							
	Praseodymium, Pr (Pr^{+3})	5.1×10^4	7.7×10^5	N	1.5×10^3	N							
	Samarium, Sm (Sm^{+3})	5.3×10^4	7.9×10^5	N	1.6×10^3	N							
	Lanthanum, La	1.1×10^5	1.7×10^6	N	3.4×10^3	N							
	Neodymium, Nd (Nd^{+3})	N	N	N	N	N							
85. URANIUM	Uranium, U (U^{+6})	9.0 x 10	6.0×10^4	5.0×10^2	1.2 x 102	1.0 x 10	N.D.						
86. THORIUM	Thorium, Th (Th^{+4})	4.2×10^2	6.3×10^3	N	1.3 x 10	N	N.D.						

*Only sample S-2-3, summation of acidic and basic. N.D. Not Detected

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 4-1. Results of Level 2 Survey Analysis for Polynuclear Organic Compounds

Sample Number	Compound Identity	Compound Quantity
S-2-1	Naphthalene	22.9 μg/g*
	Dimethylnaphthalene	49.8 μg/g*
	Phenanthrene or Anthracene	17.4 μg/g*
	Methylanthracene	22.4 μg/g*
S-2-2	None Detected	<1.0 μg/g*
S-2-3	None Detected	<19.9 μg/M^3
S-2-4	None Detected	<0.2 μg/M^3
S-2-5	Phenanthrene	117.0 μg/M^3
	Methyl Anthracene	117.0 μg/M^3
	Fluoranthene	117.0 μg/M^3
	Pyrene	34.7 μg/M^3
	Benzofluoranthene	19.3 μg/M^3
S-2-6	Phenanthrene	37.6 μg/M^3
	Fluoranthene	89.3 μg/M^3
	1, 2 - Benzanthracene	28.2 μg/M^3
S-2-7	Naphthalene	15.0 μg/M^3
	Phenanthrene or Diphenylacetylene	18.0 μg/M^3

* No Rate Data

Table 4-3. Level 2 Survey Analysis of Liquid Chromatographic Fractions

Sample Identification	Liquid Chromatographic Fraction	Compound Identity	Compound Quantity
S-2-1	1	16 Carbon Hydrocarbon	Present <16 μg/g*
		17 Carbon Hydrocarbon	16 μg/g*
		18 Carbon Hydrocarbon	16 μg/g*
		19 Carbon Hydrocarbon	16 μg/g*
		20 Carbon Hydrocarbon	Present <16 μg/g*
		Unknown	190 μg/g*
S-2-3	1	16 Carbon Hydrocarbon	Present <300 μg/M^3
		17 Carbon Hydrocarbon	Present <300 μg/M^3
		18 Carbon Hydrocarbon	Present <300 μg/M^3
		19 Carbon Hydrocarbon	Present <300 μg/M^3

Table 4-3. Level 2 Survey Analysis of (Cont'd)

Sample Identification	Liquid Chromatographic Fraction	Compound Identity	Compound Quantity
		20 Carbon Hydrocarbon	Present <300 $\mu g/M^3$
		Unknown	470 $\mu g/M^3$
S-2-4	1	16 Carbon Hydrocarbon	Present <16 $\mu g/M^3$
		17 Carbon Hydrocarbon	Present <16 $\mu g/M^3$
		18 Carbon Hydrocarbon	Present <16 $\mu g/M^3$
		19 Carbon Hydrocarbon	Present <16 $\mu g/M^3$
		20 Carbon Hydrocarbon	Present <16 $\mu g/M^3$
		Unknown	Present <16 $\mu g/M^3$
S-2-5	1	16 Carbon Hydrocarbon	Present <20 $\mu g/M^3$
		17 Carbon Hydrocarbon	20 $\mu g/M^3$
		18 Carbon Hydrocarbon	Present <20 $\mu g/M^3$
		19 Carbon Hydrocarbon	Present <20 $\mu g/M^3$
		20 Carbon Hydrocarbon	Present <20 $\mu g/M^3$
		Unknown	Present 20 $\mu g/M^3$
S-2-6	1	16 Carbon Hydrocarbon	Present <300 $\mu g/M^3$
		17 Carbon Hydrocarbon	Present <300 $\mu g/M^3$
		18 Carbon Hydrocarbon	Present <300 $\mu g/M^3$
		19 Carbon Hydrocarbon	Present <300 $\mu g/M^3$
		20 Carbon Hydrocarbon	Present <300 $\mu g/M^3$
		Unknown	Present <300 $\mu g/M^3$
S-2-7	1	None Detected	<50 $\mu g/M^3$

Table 4-3. Level 2 Survey Analysis of Liquid Chromatographic Fractions (Cont'd)

Sample Identification	Liquid Chromatographic Fraction	Compound Identity	Compound Quantity	
S-2-1	2 and 3		Unknown	80 µg/g*
		15 Carbon Hydrocarbon	Present	<6 µg/g*
		16 Carbon Hydrocarbon	Present	<6 µg/g*
		17 Carbon Hydrocarbon	Present	<6 µg/g*
		18 Carbon Hydrocarbon	Present	<6 µg/g*
		19 Carbon Hydrocarbon	Present	<6 µg/g*
		20 Carbon Hydrocarbon	Present	<6 µg/g*
		21 Carbon Hydrocarbon	Present	<6 µg/g*
		Phthalate Ester	Present	<6 µg/g*
		Unknown 2		<6 µg/g*
S-2-3	2 and 3		Unknown/ Present	<120 µg/M^3
		15 Carbon Hydrocarbon		310 µg/M^3
		16 Carbon Hydrocarbon		560 µg/M^3
		17 Carbon Hydrocarbon		1,180 µg/M^3
		18 Carbon Hydrocarbon		1,620 µg/M^3
		19 Carbon Hydrocarbon		680 µg/M^3
		20 Carbon Hydrocarbon		560 µg/M^3
		21 Carbon Hydrocarbon		310 µg/M^3
		Phthalate Ester		1,120 µg/M^3
		Unknown		120 µg/M^3

*No Rate Data

Table 4-3. Level 2 Survey Analysis of Liquid Chromatographic Fractions (Con't)

Sample Identification	Liquid Chromatographic Fraction	Compound Identify	Compound Quantity
S-2-4	2 and 3		Unknown Present < 7 $\mu g/M^3$
		15 Carbon Hydrocarbon	Present < 7 $\mu g/M^3$
		16 Carbon Hydrocarbon	Present < 7 $\mu g/M^3$
		17 Carbon Hydrocarbon	30 $\mu g/M^3$
		18 Carbon Hydrocarbon	23 $\mu g/M^3$
		19 Carbon Hydrocarbon	Present < 7 $\mu g/M^3$
		20 Carbon Hydrocarbon	Present < 7 $\mu g/M^3$
		21 Carbon Hydrocarbon	Present < 7 $\mu g/M^3$
		Phthalate Ester	16 $\mu g/M^3$
		Unknown	2 Present < 7 $\mu g/M^3$
S-2-5	2 and 3		Unknown/ Present <10 $\mu g/M^3$
		15 Carbon Hydrocarbon	10 $\mu g/M^3$
		16 Carbon Hydrocarbon	20 $\mu g/M^3$
		17 Carbon Hydrocarbon	30 $\mu g/M^3$
		18 Carbon Hydrocarbon	50 $\mu g/M^3$
		19 Carbon Hydrocarbon	30 $\mu g/M^3$
		20 Carbon Hydrocarbon	20 $\mu g/M^3$
		21 Carbon Hydrocarbon	10 $\mu g/M^3$

Table 4-3. Level 2 Survey Analysis of Liquid Chromatographic Fractions (Con't)

Sample Identification	Liquid Chromatographic Fraction	Compound Identify	Compound Quantity
S-2-6	2 and 3		Unknown/ Present <120 μg/M^3
		15 Carbon Hydrocarbon	Present <120 μg/M^3
		16 Carbon Hydrocarbon	Present <120 μg/M^3
		17 Carbon Hydrocarbon	180 μg/M^3
		18 Carbon Hydrocarbon	180 μg/M^3
		19 Carbon Hydrocarbon	120 μg/M^3
		20 Carbon Hydrocarbon	60 μg/M^3
		21 Carbon Hydrocarbon	60 μg/M^3
		Phthalate Ester	Present <120 μg/M^3
		Unknown	180 μg/M^3
S-2-7	2 and 3	None Detected	<50 μg/M^3
S-2-1	4 and 5	Phthalate Ester	25 μg/g*
		Unknown	50 μg/g*
		Unknown	60 μg/g*
S-2-3	4 and 5	Phthalate Ester	1,120 μg/M^3
		Unknown	870 μg/M^3
		Unknown	1,180 μg/M^3
S-2-4	4 and 5	Phthalate Ester	50 μg/M^3
		Unknown	80 μg/M^3
		Unknown	1/2 Present <7 μg/M^3

*No Rate Data

Table 4-3. Level 2 Survey Analysis of Liquid Chromatographic Fractions (Con't)

Sample Identification	Liquid Chromatographic Fraction	Compound Identify		Compound Quantity
S-2-5	4 and 5	Phthalate Ester	Present	<10 $\mu g/M^3$
		Unknown		550 $\mu g/M^3$
		Unknown	Present	<10 $\mu g/M^3$
S-2-6	4 and 5	Phthalate Ester		2,120 $\mu g/M^3$
		Unknown		5,500 $\mu g/M^3$
		Unknown	Present	<120 $\mu g/M^3$
S-2-7	4 and 5	None Detected		<50 $\mu g/M^3$
S-2-1	6 and 7	Propyl Phthalate	Present	<6 $\mu g/g$*
		Unknown		220 $\mu g/g$*
		Unknown	Present	<6 $\mu g/g$*
		Phthalate Ester	Present	<6 $\mu g/g$*
S-2-3	6 and 7	Propyl Phthalate		4,100 $\mu g/M^3$
		Unknown		1,300 $\mu g/M^3$
		Unknown		1,740 $\mu g/M^3$
		Phthalate Ester		120 $\mu g/M^3$
S-2-4	6 and 7	Propyl Phthalate	Present	<7 $\mu g/M^3$
		Unknown	Present	<7 $\mu g/M^3$
		Unknown	Present	<7 $\mu g/M^3$
		Phthalate Ester		410 $\mu g/M^3$
S-2-5	6 and 7	Propyl Phthalate	Present	<10 $\mu g/M^3$
		Unknown		120 $\mu g/M^3$
		Unknown		470 $\mu g/M^3$
		Phthalate Ester		620 $\mu g/M^3$

*No Rate Data

Table 4-3. Level 2 Survey Analysis of Liquid Chromatographic Fractions (Con't)

Sample Identification	Liquid Chromatographic Fraction	Compound Identify	Compound Quantity
S-2-6	6 and 7	Propyl Phthalate	Present <120 $\mu g/M^3$
		Unknown	Present <120 $\mu g/M^3$
		Unknown	Present <120 $\mu g/M^3$
		Phthalate Ester	Present <120 $\mu g/M^3$
S-2-7	6 and 7	Unknown	280 $\mu g/M^3$

*No Rate Data

Table 4-4. Results of Chemical Ionization GC/MS Analysis

SAMPLE / LC Fraction	MW176	COMPOUND[1]		2nd Hydrocarbon	Phthalate Ester	Hydrocarbon MW 394
		Butyl Phthalate	1st Hydrocarbon MW 332			
S-2-1/1				X		
S-2-1	X					
S-2-3/2&3	X	X	X		X	
S-2-3/6&7	X					
S-2-7/6&7	X				X	X

[1] See text for further compound information.

ADDITIONAL DATA

Table 2-2. Total Emission Data From 6-inch FBC Unit*

LEVEL 1 - LEVEL 2 DATA REDUCTION TABLES, REV. II.

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE^4 µg/m^3 (ppm) µg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPECTATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
1. ALIPHATIC HYDROCARBONS A. ALKANES AND CYCLIC ALKANES	Hexanes	3.6 x 10^5 (100)	5.4 x 10^6	1.0 x 10^5	1.1 x 10^4	>2.0 x 10^2	GAS, FIELD, C6	N.D.						
	Nonanes	1.05 x 10^6 (200)	1.57 x 10^7	N	3.2 x 10^4	N	SASS, LAB, C9	N.D.						
	Cyclohexane	1.05 x 10^6 (300)	1.58 x 10^7	1.0 x 10^3	3.2 x 10^4	2.0	GAS, FIELD, C6	N.D.						
	Butanes	1.4 x 10^6 (600)	2.1 x 10^7	>1.0 x 10^5	4.2 x 10^4	>2.0 x 10^2	GAS, FIELD, C4	N.D.						
	Octanes	1.45 x 10^6 (300)	2.18 x 10^7	N	4.4 x 10^4	N	SASS, LAB, C8	N.D.						
	Heptanes	1.6 x 10^6 (400)	2.4 x 10^7	1.0 x 10^5	4.8 x 10^4	2.0 x 10^2	SASS, LAB, C7	N.D.						
	Pentanes	1.8 x 10^6 (600)	2.7 x 10^7	1.0 x 10^3	5.4 x 10^4	2.0	GAS, FIELD, C5	N.D.						
	Methane	3.3 x 10^6 (5000)	4.91 x 10^7	>1.0 x 10^5	9.8 x 10^4	>2.0 x 10^2	GAS, FIELD, C1	N.D.						
	Ethane	6.12 x 10^6 (5000)	9.18 x 10^7	N	1.8 x 10^5	N	GAS, FIELD, C2	N.D.						
	Propane	9.0 x 10^6 (5000)	1.35 x 10^8	>1.0 x 10^5	2.8 x 10^5	>2.0 x 10^2	GAS, FIELD, C3	N.D.						
	Cyclopetane	N	N	>1.0 x 10^5	1.1 x 10^4	>2.0 x 10^2	GAS, FIELD, C5	N.D.						
	Alkanes (C>9)	N	N	N	N	N	SASS, LAB, C10-12, LC1	7.6x10^2	N					
B. ALKENES, CYCLIC Alkenes and Dienes	Cyclopentadienes	2.0 x 10^5 (75)	3.0 x 10^6	N	6.0 x 10^3	N	GAS, FIELD, C5	N.D.						
	Cyclohexene	1.0 x 10^6 (300)	1.5 x 10^7	N	3.0 x 10^4	N	GAS, FIELD, C6	N.D.						
	Hexenes	1.02 x 10^6 (300)	1.53 x 10^7	N	N	N	GAS, FIELD, C6	N.D.						
	Butadienes	2.2 x 10^6 (1000)	3.3 x 10^7	1.0 x 10^3	6.6 x 10^4	2.0	GAS, FIELD, C3	N.D.						
	Ethylene	5.71 x 10^6 (5000)	8.57 x 10^7	1.0 x 10^4	1.7 x 10^5	2.0 x 10	GAS, FIELD, C1	N.D.						
	Propylene	8.59 x 10^6 (5000)	1.29 x 10^8	1.0 x 10^5	2.6 x 10^5	2.0 x 10^2	GAS, FIELD, C2	N.D.						
	Butylenes	N	N	N	N	N	GAS, FIELD, C3	N.D.						
	Pentenes	N	N	N	N	N	GAS, FIELD, C5	N.D.						
	Cyclohexadiene	N	N	N	N	N	GAS, FIELD, C5	N.D.						
	Heptenes	N	N	1.0 x 10^5	N	2.0 x 10^2	GAS, FIELD, C6	N.D.						
C. ALKYNES	Propyne	1.65 x 10^6 (1000)	2.48 x 10^7	N	5.0 x 10^4	N	GAS, FIELD, C3	N.D.						
	Acetylene	5.31 x 10^6 (5000)	7.97 x 10^7	N	1.6 x 10^5	N	GAS, FIELD, C2	N.D.						
	Butyne	N	N	N	N	N	GAS, FIELD, C3	N.D.						
2. HALOGENATED ALIPHATIC HYDROCARBON A. SATURATED ALKYL HALIDES	Hexachlorocyclohexane (Lindone)	5.0 x 10^2	7.50 x 10^3	1.0 x 10^2	1.5 x 10^1	2.0 x 10^{-1}	SASS, .AB, C11	N.D.						
	Methyl iodide	8.54 x 10^2	1.28 x 10^4	N	2.6 x 10^1	N	GAS, FIELD, C5	N.D.						

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN
   - A. AAS
   - B. XRD
   - C. WET CHEMICAL
   - D. ESCA
   - E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m^3 (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE μg/m^3 (ppm) μg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Tribromomethane	5.0 x 10^3 (0.5)	7.5 x 10^4	N	1.5 x 10^2	N	SASS, LAB, C10	N.D.						
	Hexachloroethane	1.0 x 10^4 (1)	1.5 x 10^5	N	3.0 x 10^2	N	SASS, LAB, C11	N.D.						
	1,1,2-Trichloroethane	4.5 x 10^4 (10)	6.75 x 10^5	1.0 x 10^3	1.4 x 10^3	2.0	GAS, FIELD, C5	N.D.						
	Carbon tetrachloride	5.98 x 10^4	8.97 x 10^5	1.0 x 10^3	1.8 x 10^3	2.0	GAS, FIELD, C5	N.D.						
	Methyl bromide	6.0 x 10^4 (15)	9.0 x 10^5	>1.0 x 10^5	1.8 x 10^3	.72.0 x 10^2	GAS, FIELD, C4	N.D.						
	Chloroform	1.2 x 10^5 (25)	6.0 x 10^5	N	1.2 x 10^3	N	GAS, FIELD, C6	N.D.						
	1,2-Dichloroethane	2.0 x 10^5 (50)	3.0 x 10^6	1.0 x 10^4	6.0 x 10^3	2.0 x 10^1	GAS, FIELD, C5	N.D.						
	Methyl chloride	2.1 x 10^5 (100)	3.15 x 10^6	>1.0 x 10^5	6.4 x 10^3	2.0 x 10^2	GAS, FIELD, C3	N.D.						
	Dichloropropanes	3.5 x 10^5 (75)	5.25 x 10^6	1.0 x 10^3	1.1 x 10^4	2.0	GAS, FIELD, C6	N.D.						
	Dichloromethane	7.2 x 10^5 (200)	1.08 x 10^7	4.5 x 10^3			SASS, LAB, C8	N.D.						
	Bromochloromethane	1.1 x 10^6 (200)	1.7 x 10^7	N	3.4 x 10^4	N	GAS, FIELD, C6	N.D.						
	1,2-Dichloro-1,2-difluoroethane	4.95 x 10^6 (1000)	7.43 x 10^7	N	1.5 x 10^5	N	GAS, FIELD, C5	N.D.						
	Dichlorodifluoromethane	4.95 x 10^6 (1000)	7.43 x 10^7	>1.0 x 10^5	1.5 x 10^5	72.0 x 10^2	GAS, FIELD, C3	N.D.						
	Trichlorofluoromethane	5.6 x 10^6	8.4 x 10^6	N	1.7 x 10^5	N	GAS, FIELD, C4	N.D.						
	Bromodichloromethane	N	N	N	N	N	GAS, FIELD, C6	N.D.						
	Dibromodichloromethane	N	N	N	N	N	GAS, FIELD, C8	N.D.						
	Bromobutanes	N	N	N	N	N	SASS, LAB, C7	N.D.						
	1-Chlorooctane	N	N	N	N	N	SASS, LAB, C11	N.D.						
B. UNSATURED ALKYL HALIDES	Hexachlorocyclopentadiene	1.1 x 10^2 (0.01)	1.65 x 10^3	N	3.4	N	SASS, LAB, LC2	7.4x10^2	6.7	Yes	1-E	1	1	1
	Chloroethene	2.55 x 10^3 (1)	3.83 x 10^4	>71.0 x 10^5	7.6 x 10^1	2.0 x 10^2	GAS, FIELD, C3	N.D.						
	Hexachlorobutadiene	4.0 x 10^3	6.07 x 10^4	N	1.2 x 10^2	N	SASS, LAB, LC2	7.4x10^2	6.7	Yes	1-E	1	1	1
	Dichloropropenes	1.12 x 10^4	1.68 x 10^5	1.0 x 10^3	3.4 x 10^2	2.0	GAS, FIELD, C6	N.D.						
	1,1-Dichloroethene	2.59 x 10^5	3.88 x 10^6	4.5 x 10^3			GAS, FIELD, C5	N.D.						
	Tetrachloroethene	6.7 x 10^5 (100)	1.01 x 10^7	1.0 x 10^3	2.0 x 10^4	2.0	SASS, LAB, C8	N.D.						
	1,2-Dichloroethene	7.0 x 10^5 (200)	1.10 x 10^7	1.0 x 10^4	2.2 x 10^4	2.0 x 10^1	GAS, FIELD, C5	N.D.						
3. ETHERS	2-Ethyl-4-Methyl-1,3-Dioxolanes	2.25 x 10^4	3.38 x 10^5	N	6.8 x 10^2	N	SASS, LAB, C8	N.D.						
	1,3-Dioxane	1.8 x 10^5 (50)	2.7 x 10^6	N	5.4 x 10^3	2.0 x 10^1	SASS, LAB, C7	N.D.						
	1,4-Dioxane	1.8 x 10^5	2.7 x 10^6	1.0 x 10^4	5.4 x 10^3	2.0 x 10^1	SASS, LAB, C7	N.D.						
	Isopropyl ether	1.05 x 10^6 (250)	1.58 x 10^7	1.0 x 10^4	3.2 x 10^4	2.0 x 10^1	SASS, LAB, C7	N.D.						
	2-Methoxybiphenyl	N	N	N	N	N	SASS, LAB, C7	N.D.						

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6, and S-2-7.

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
4. HALOGENATED ETHERS	1,1-Dichlorodi-ethyl ether	3.0×10^{4} (5)	4.5×10^{5}	N	9.0×10^{2}	N	SASS, LAB, C7	N.D.						
	1,2-Dichloro-ethyl ether	3.0×10^{4} (5)	4.5×10^{5}	4.5×10^{3}	N	N	SASS, LAB, C9	N.D.						
	2,2-Dichlorodi-ethyl ether	3.0×10^{4} (5)	4.5×10^{5}	1.0×10^{4}	9.0×10^{2}	2.0×10^{1}	SASS, LAB, C10	N.D.						
	Chloromethyl methyl ether	3.68×10^{4}	5.52×10^{5}	4.5×10^{3}	1.1×10^{3}	9.0	GAS, FIELD, C5	N.D.						
	1,1-Dichloro-methyl ether	N	N	N	N	N	SASS, LAB, C7	N.D.						
	2-Chloro-1,2 epoxypropane	N	N	N	N	N	SASS, LAB, LC4	4×10^{2}	N					
	2-Chloroethyl methyl ether	N	N	N	N	N	GAS, FIELD, C6	N.D.						
	1-Chloro-1,2-oxetane	N	N	N	N	N	SASS, LAB, C7	N.D.						
	Chloroethylethyl ether	N	N	N	N	N	SASS, LAB, C7	N.D.						
	1,2-Dichloroethyl ethyl ether	N	N	N	N	N	SASS, LAB, C9	N.D.						
	a-Chlorobutyl-ethyl ether	N	N	N	N	N	SASS, LAB, C10	N.D.						
	bis-(1-Chloroiso-propyl) ether	N	N	N	N	N	SASS, LAB, C11	N.D.						
	Bromophenyl phenyl ether	N	N	N	N	N	SASS, LAB, LC4	4×10^{2}	N					
5. ALCOHOLS	a-Hydroxytholyene	5.5×10^{-4}	8.3×10^{5}	1.0×10^{4}	1.7×10^{3}	2.0×10^{1}	SASS, LAB, C12	N.D.						
A. PRIMARY ALCOHOLS	Isobutylalcohol	1.5×10^{5} (50)	2.3×10^{6}	1.0×10^{4}	4.5×10^{3}	2.0×10^{1}	SASS, LAB, C7	N.D.						
	Pentanols (Primary)	3.6×10^{5} (100)	5.4×10^{6}	1.0×10^{4}	1.1×10^{4}	2.0×10^{1}	SASS, LAB, C8	N.D.						
	1-Propanol	5.0×10^{5}	7.5×10^{6}	1.0×10^{4}	1.5×10^{4}	2.0×10^{1}	GAS, FIELD, C6	N.D.						
	Butanols (Primary) N-Butanol	1.5×10^{5} (50)	2.25×10^{6}	$>1.0 \times 10^{5}$	4.5×10^{3}	2.0×10^{2}	SASS, LAB, C8	N.D.						
	Methanol	2.6×10^{5} (200)	3.9×10^{6}	$>1.0 \times 10^{5}$	7.8×10^{3}	2.0×10^{2}	GAS, FIELD, C6	N.D.						
	Ethanol	1.9×10^{6} (1000)	2.85×10^{7}	$>1.0 \times 10^{5}$	5.8×10^{4}	2.0×10^{2}	GAS, FIELD, C6	N.D.						
B. SECONDARY ALCOHOLS	Phenyl Ethanol	1.8×10^{4}	2.7×10^{5}	N	5.4×10^{2}	N	SASS, LAB, LC6	3.6×10^{2}	0.02	NO				
	Benzyl	5.54×10^{4}	8.31×10^{5}	1.0×10^{4}			SASS, LAB, LC6	3.6×10^{2}						
	Borneol	9.0×10^{4}	1.35×10^{6}	N	4.8×10^{3}	N	SASS, LAB, LC6	3.6×10^{2}						
	2,6-Dimethyl-4-heptanol	1.6×10^{5}	2.4×10^{6}	N	4.8×10^{3}	N	SASS, LAB, C6	N.D.						

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE.
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch EBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m³ (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE μg/m³ (ppm) μg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPEC-TATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
C. TERTIARY ALCOHOLS	Pentonols (secondary)	3.6×10^5 (100)	5.4×10^6	N	1.1×10^4	N	SASS, LAB, C8	N.D.						
	2-Butanol	4.8×10^5 (150)	6.75×10^6	$>1.0 \times 10^5$	1.4×10^4	2.0×10^2	GAS, FIELD, C6	N.D.						
	2-Propanol	9.8×10^5 (400)	1.47×10^7	1.0×10^4	3.0×10^4	2.0×10	GAS, FIELD, C6	N.D.						
	Tertiary Pentanol	4.5×10^4	6.75×10^5	$>1.0 \times 10^5$	1.4×10^3	2.0×10^2	GAS, FIELD, C6	N.D.						
	α-Terpineol	1.95×10^5	2.89×10^6	N	5.8×10^3	N	SASS, LAB, LC6	3.6×10^2	0.002	NO				
	Tertiary Butanol	3.0×10^5 (100)	4.5×10^6	$>1.0 \times 10^5$	9.0×10^3	2.0×10^2		N.D.						
	Isoborneol	N	N	N	N	N	SASS, LAB, LC6	3.6×10^2	N					
6. GLYCOLS, EPOXIDES A. GLYCOLS	Ethylene glycol	1.0×10^4	1.5×10^5	1.0×10^4	3.0×10^2	2.0×10^1	SASS, LAB, C11	N.D.						
	Propylene glycol	3.6×10^5 (100)	5.4×10^6	$>1.0 \times 10^5$	1.1×10^4	2.0 x 102	SASS, LAB, C11	N.D.						
B. EPOXIDES	1-Chloro-2,3-epoxypropane	1.63×10^4	2.45×10^5	1.0×10^3	4.8×10^2	2.0	SASS, LAB, C8	N.D.						
	2,3-Epoxy-1-propanol	1.5×10^4 (50)	2.3×10^5	N	5.2×10^3	N	SASS, LAB, C10	N.D.						
7. ALDEHYDES, KETONES A. ALDEHYDES	Acrolein	2.5×10^2 (0.1)	3.75×10^3	$<1.0 \times 10^2$	7.5	2.0×10^{-1}	GAS, FIELD, C5	N.D.						
	Formaldehyde	1.6×10^3	2.4×10^4	1.0×10^3	4.8×10^1	2.0	GAS, FIELD, C3	N.D.						
	Propionaldehyde	3.6×10^4	5.4×10^5	1.0×10^4	1.1×10^3	2.0×10	GAS, FIELD, C5	N.D.						
	Benzaldehyde	5.83×10^4	8.77×10^5	N	1.8×10^3	N	SASS, LAB, C10	N.D.						
	Butyraldehyde	1.12×10^5	1.68×10^6	1.0×10^2	3.3×10^3	2.0×10^{-1}	GAS, FIELD, C6	N.D.						
	Acetaldehyde	1.8×10^5 (100)	2.7×10^6	N	5.4×10^3	N	GAS, FIELD, C4	N.D.						
	3-Methylbutanal	3.86×10^5	5.79×10^6	1.0×10^3	1.2×10^4	2.0	GAS, FIELD, C6	N.D.						
B. KETONES	Camphor	1.2×10^4 (2)	1.8×10^5	N	3.6×10^2	N	SASS, LAB, LC4	4.1×10^2	0.034	NO				
	Isophorone	2.5×10^4	3.75×10^5	N	7.5×10^2	N	SASS, LAB, LC4	4.1×10^2		NO				
	Acetophenone	4.05×10^4	6.07×10^5	N	1.2×10^3	N	SASS, LAB, LC4	4.1×10^2		NO				
	Acetone	2.4×10^6 (1000)	3.6×10^7	$>1.0 \times 10^5$	7.2×10^4	$>2.0 \times 10^2$	GAS, FIELD, C5	N.D.						
	Butanone	5.9×10^6 (200)	8.85×10^6	$>1.0 \times 10^5$	1.8×10^4	$>2.0 \times 10^2$	GAS, FIELD, C6	N.D.						
	Tetrachloro-acetone	N	N	N	N	N	SASS, LAB, C11	N.D.						
	Chlorohydroxy Benzophenone	N	N	N	N	N	SASS, LAB, LC4	4.1×10^2	N					
	5,6-Benzo-9-Anthrone	N	N	N	N	N	SASS, LAB, LC4	4.1×10^2	N					
	Dihydro(d)carvone	N	N	N	N	N	SASS, LAB, LC4	4.1×10^2	N					

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m³ (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE μg/m³ (ppm) μg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPECTATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
8. CARBOXYLIC ACIDS	Maleic	1.0×10^3 (0.25)	1.5×10^4	N	3.0×10^1	N	SASS, LAB, C8	N.D.						
A. CARBOXYLIC ACIDS	Phthalic	6.0×10^3 (1:0)	9.0×10^4	N	1.8×10^2	N	SASS, LAB, LC7 & 8	8.2×10^2	0.14	NO				
	Formic	9.0×10^3 (5.0)	1.4×10^5	N	2.7×10^2	N	SASS, LAB, C8	N.D.						
	Acetic	2.5×10^4 (10)	3.8×10^5	1.0×10^3	7.6×10^2	2.0	SASS, LAB, LC7 & 8	8.2×10^2		NO				
	Benzoic	1.4×10^5	2.1×10^6	N	4.2×10^3	N	SASS, LAB, C8, 8 & LC7	8.2×10^2		NO				
	Long Chain	N	N	N	N	N	SASS, LAB, C8, 8 & LC7	8.2×10^2		NO				
B. CARBOXYLIC ACIDS WITH ADDITIONAL FUNCTIONAL GROUPS	3-Hydroxypropanoic Acid Lactone	3.17×10^2	4.76×10^3	1.0×10^4	9.6	2.0×10	SASS, LAB, C10	N.D.						
	β-Propiolactone	3.2×10^2	1.6×10^3	N	3.2	N								
	Hydroxybenzoic Acid	4.01×10^4	6.01×10^5	N	1.2×10^3	N	SASS, LAB, C7	N.D.						
	Hydroxyacetic Acid	8.78×10^4	1.13×10^6	N	2.6×10^3	N	SASS, LAB, LC7	8.2×10^2		NO				
C. AMIDES	6-Hevanelactam	1.0×10^3	1.5×10^4	N	3.0	N	SASS, LAB, C7	N.D.						
	Formamide	3.0×10^4 (20)	4.5×10^5	N	9.0×10^2	N	SASS, LAB, LC7	8.2×10^2	0.03	NO				
	Acetamide	4.5×10^5	6.75×10^6	N	1.4×10^4	N	SASS, LAB, LC7	8.2×10^2		NO				
	6-Aminohexanoic Acid	2.33×10^6	3.5×10^7	N	N	N	SASS, LAB, LC8	8.2×10^2		NO				
D. ESTERS	Phthalates	5.0×10^3	7.5×10^4	1.5	1.5×10^2	3.0×10^{-3}	SASS, LAB, LC6	3.6×10^2	0.07	NO				
	Methyl Methacrylate	4.1×10^5 (100)	6.2×10^6	1.0×10^4	1.2×10^4	2.0×10	SASS, LAB, C7	N.D.						
	Adipates	1.89×10^4	2.83×10^5	N	5.6×10^2		SASS, LAB, C8, 9 & 10	N.D.						
	Methyl Benzoate	1.5×10^5	2.25×10^6	N	4.6×10^3	N	SASS, LAB, C10	N.D.						
	Phenyl Benzoate	N	N	N	N	N	SASS, LAB, LC6	3.6×10^2	N					
	Di-2-ethylhexyl phthalate	N	N	N	N	N	SASS, LAB, LC6	3.6×10^2						
	Long chain esters	N	N	N	N	N	SASS, LAB, LC6	3.6×10^2						
9. NITRILES	1-Cyanoethane	1.76×10^3	2.64×10^4	N	5.4×10	N	GAS, FIELD, C6	N.D.						
	Tetramethyl-succinonitrile	3.0×10^3 (0.5)	4.5×10^4	N	9.0×10	N	SASS, LAB, LC4	4.1×10^2	0.13	NO				
	Butyronitrile	2.25×10^4	3.37×10^5	N	6.8×10^2	N	SASS, LAB, LC4	4.1×10^2		NO				
	Benzonitrile	3.24×10^4	4.86×10^5	N	1.4×10^3	2.0	SASS, LAB, C11	N.D.						
	Acrylonitrile	4.5×10^4 (20)	6.8×10^5	1.0×10^3	1.4×10^3		SASS, LAB, C11	N.D.						
	Acetonitrile	7.0×10^4 (40)	1.05×10^6	1.0×10^5	2.1×10^3	2.0×10^2	GAS, FIELD, C6	N.D.						
	Naphthonitriles	N	N	N	N	N	SASS, LAB, LC4	4.1×10^2	N					

*Summation of S-2-6, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN
   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^{1}	TEST EXPECTATIONS^{2}	TEST COST^{3}	SAMPLE ALIQUOT^{4}
10. AMINES	1-Aminonaphtalene	5.5×10^{2}	8.5×10^{3}	1.0×10^{2}			SASS, LAB, LC7	8.2×10^{2}	1.5	YES	1-E	1	1	1
A. PRIMARY	Methylamine	1.81×10^{3}	2.72×10^{4}	N	3.6×10	2.0	SASS, LAB, LC6	3.6×10^{2}	0.19	NO				
	4-Aminibiphenyl	1.2×10^{3} (10)	1.8×10^{4}	1.0×10^{3}			GAS, FIELD, C6	N.D.						
	Ethanolamine	6.0×10^{3} (3)	9.0×10^{4}	1.0×10^{4}	1.8×10^{2}	2.0×10	SASS, LAB, C10	N.D.						
	Butylamines	1.5×10^{4} (5)	2.25×10^{5}	$>1.0 \times 10^{5}$	4.5×10^{2}	2.0×10^{2}	GAS, FIELD, C6	N.D.						
	Ethylamine	1.8×10^{4} (10)	2.7×10^{5}	1.0×10^{3}	5.4×10^{2}	2.0	GAS, FIELD, C4	N.D.						
	1,2-Diaminoethane	2.5×10^{4} (10)	3.75×10^{5}	1.0×10^{3}	7.6×10^{2}	2.0	SASS, LAB, C8	N.D.						
	Cyclohexylamine	4.0×10^{4} (10)	6.0×10^{5}	1.0×10^{4}	1.2×10^{3}	2.0×10	SASS, LAB, C8	N.D.						
	Propanolamine	1.27×10^{5}	1.9×10^{6}	N	3.8×10^{3}	N	SASS, LAB, C9	N.D.						
	3-Aminopropene	N	N	N	N	N	GAS, FIELD, C5	N.D.						
B. SECONDARY	Ethyleneimine	3.33×10^{2}	5.0×10^{3}	N	1.0×10	N	GAS, FIELD, C3?	N.D.						
	Dimethylamine	1.8×10^{4} (10)	2.7×10^{5}	1.0×10^{3}	5.4×10^{2}	2.0	GAS, FIELD, C3?	N.D.						
	Morpholine	7.0×10^{4} (20)	1.05×10^{6}	1.0×10^{4}	2.1×10^{3}	2.0×10	SASS, LAB, LC6?	3.6×10^{2}	0.005	NO				
	Diethylamine	7.5×10^{4} (25)	1.13×10^{6}	1.0×10^{3}	2.2×10^{3}	2.0	GAS, FIELD, C3?	N.D.						
	Ethylmethylamine	N	N	N	N	N	GAS, FIELD, C4?	N.D.						
C. TERTIARY AMINES	Aminotoluenes	1.1×10^{2}	1.7×10^{3}	N	3.0	N	SASS, LAB, C11	N.D.						
	2-Aminonaphthalene	1.7×10^{2}	2.5×10^{3}	1.0×10^{2}	5.0	2.0×10^{-1}	SASS, LAB, LC6	3.6×10^{2}	2.1	YES	1-E	1	1	1
	4,4^{1}-Methylene-bis-(2-chloro-aniline	2.18×10^{2}	3.27×10^{3}	N	6.0	N	SASS, LAB, LC7	8.2×10^{2}	3.8	YES	1-E	1	1	1
	Anisidines	5.0×10^{2} (0.1)	7.5×10^{3}	N	1.5×10	N	SASS, LAB, LC6	3.6×10^{2}	0.7	YES	1-E	1	1	1
	4-Aminibiphenyl	1.3×10^{3}	2.0×10^{4}	N	4.0	N	SASS, LAB, LC6	3.6×10^{2}						
	1,4-Diaminobenzene	4.5×10^{3}	6.75×10^{4}	N	1.4×10^{3}	N	SASS, LAB, LC6	3.6×10^{2}						
	3,3'-Dichloro-benzidine	6.6×10^{3}	9.9×10^{4}	N	2.0×10^{2}	N	SASS, LAB, LC7	8.2×10^{2}						
	Benzidine	1.4×10^{4}	2.1×10^{5}	1.0×10^{2}	4.2×10^{2}	2.0×10^{-1}	SASS, LAB, LC7	8.2×10^{2}						
	Aniline	1.9×10^{4} (5)	2.85×10^{5}	1.0×10^{3}	6.0×10^{2}	2.0	SASS, LAB, C11	N.D.						
	Dimethylaniline	2.5×10^{4} (5)	3.75×10^{5}	N	7.5×10^{2}	N	SASS, LAB, C11	N.D.						
	N,N-Dimethyl-aniline	2.5×10^{4} (5)	3.83×10^{5}	N	7.5×10^{2}	N	SASS, LAB, LC6	3.6×10^{2}						
11. AZO COMPOUNDS	N,N'-Dimethyl-hydrazine	3.17×10	4.76×10^{2}	N	1.0	N	GAS, FIELD, C6	N.D.						
	Monoethyl-hydrazine	3.5×10^{2} (0.2)	5.25×10^{3}	N	1.1×10	N	GAS, FIELD, C6	N.D.						
	Diazomethane	4.0×10^{2} (0.2)	6.0×10^{3}	N	1.2×10	N	GAS, FIELD, C3	N.D.						
	N,N-Dimethyl-hydrazine	1.0×10^{3} (0.5)	1.5×10^{4}	N	3.0×10	N	SASS, LA3, C8	N.D.						
	Hydrazobenzene	1.35×10^{4}	2.02×10^{5}	N			GAS, FIELD, C6	N.D.						
	Diphenylhydrazines	1.4×10^{4}	2.0×10^{5}	N	4.0×10^{2}	N	SASS, LAB, LC7	8.2×10^{2}	0.001	NO				
	Hydrazine	N	N	N			SASS, LAB, C8	N.D.						

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m^3 (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE μg/m^3 (ppm) μg/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
12. NITROSAMIES	N-Nitroso-Dimethylamine	1.2	1.8×10	N	3.6×10^{-2}	N	SASS, LAB, C9	N.D.						
	N-Nitroso-Diethylamine	1.21×10^2	1.82×10^3	N	3.6	N	SASS, LAB, C10	N.D.						
	N-Methyl-N-Nitroso-Amiline	1.29×10^3	1.94×10^4	N	3.8×10	N	SASS, LAB, LC5	2.4×10^2	0.18	NO				
	N-Nitrosp-Di-propylaime	2.41×10^3	3.62×10^4	N	7.2×10	N	SASS, LAB, C12 & LC5	2.4×10^2						
	N-Nitroso-Di-phenylamine	7.4×10^4	1.1×10^6	N	2.2×10^3	N	SASS, LAB, LC5	2.4×10^2						
	N-Nitroso-Diiso-propylamine	3.83×10^4	5.75×10^5	N	1.2×10^3	N	SASS, LAB, C11	N.D.						
	N-Nitroso-Di-pentylamine	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
13. MERCAPTANS, SULFIDES A. MERCAPTANS	Perchloromethyl Mercaptan	8.0×10^2 (0.1)	1.2×10^4	N	2.4×10	N	SASS, LAB, LC6	3.6×10^2	0.45	YES	1-E	1	1	1
	Methyl Mercaptan	1.0×10^3 (0.5)	1.5×10^4	N	3.0×10	N	GAS, FIELD, SGC	N.D.						
	Ethyl Mercaptan	1.0×10^3 (0.5)	1.5×10^4	N	3.0×10	N	GAS, FIELD, SGC	N.D.						
	Butyl Mercaptans	1.5×10^3 (0.5)	2.25×10^4	N	4.5×10	N	GAS, FIELD, SGC	N.D.						
	Benzenthiol	2.07×10^3	3.10×10^4	N	6.2×10	N	SASS, LAB, LC6	3.6×10^2						
	Propyl Mercaptans	8.06×10^4	1.21×10^6	N	2.4×10^3	N	GAS, FIELD, SGC	N.D.						
	1-Anthranthiol	N	N	N	N	N	SASS, LAB, LC6	3.6×10^2						
B. SULFIDES DISULFIDES	Dimethyl Sulfide	2.41×10^4	3.61×10^5	N	7.2×10^2	N	GAS, FIELD, SGC	N.D.						
	Phenyl Sulfide	9.63×10^4	1.44×10^6	N	2.9	N	SASS, LAB, C9 & LC5	2.4×10^2						
	Diethyl Sulfide	N	N	N	N	N	GAS, FIELD, SGC	N.D.						
	Methyl Disulfide	N	N	N	N	N	SASS, LAB, C8	N.D.						
14. SULFONIC ACIDS, SULFOXIDES A. SULFONIC ACIDS	Benzensulfonic Acid	4.01×10^4	6.01×10^5	N	1.2×10^3	N	SASS, LAB, LC8	7.6×10	0.002	NO				
	9,10-Anthraquinone-Disulfonic Acid	N	N	N	N	N	SASS, LAB, LC8	7.6×10						
B. SULFOXIDES	Dimethyl Sulfoxide	8.14×10^2	1.22×10^3	N	2.4	N	SASS, LAB, C11	N.D.						

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE µg/m^3 (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPECTATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
15. BENZENE, SUBSTITUTED BENZENE	Biphenyl	1.0×10^3 (0.2)	1.5×10^4	N	3.0×10	N	SASS, LAB, LC2	7.4×10^2	0.73	YES	1-E	1	1	1
	Benzene	3.0×10^3 (10)	4.5×10^4	1.0×10^3	9.0×10	2.0	GAS, FIELD, C6	N.D.						
	Terphenyls	9.0×10^3 (1)	1.35×10^5	N	2.8×10^2	N	SASS, LAB, LC3	5.1×10^3	0.06	NO				
	Indene	4.5×10^4 (10)	6.8×10^5	1.0×10^3	1.4	N	SASS, LAB, LC3	5.1×10^3						
	Isopropyl Benzene	6.3×10^4	9.45×10^5	4.5×10^2	1.9×10^3	2.0	SASS, LAB, C9	N.D.						
	Trimethyl Benzenes	1.2×10^5 (25)	1.8×10^6	N	3.6×10^3	N	SASS, LAB, C10	N.D.						
	Dihydronaphthalenes	1.27×10^5	1.91×10^6	1.0×10^3	4.0×10^3	2.0	SASS, LAB, LC2	7.4×10^2						
	Tetrahydronaphthalenes	1.29×10^5	1.94×10^6	1.0×10^3	4.0×10^3	2.0	SASS, LAB, C12, LC2	7.4×10^2						
	Propyl Benzene	2.17×10^5	3.25×10^6	1.0×10^3	6.6×10^3	2.0	SASS, LAB, C9	N.D.						
	Dialkyl Benzene	2.25×10^5	3.38×10^6	1.0×10^3	6.8×10^3	2.0	SASS, LAB, C10, 11, 12	N.D.						
	Butyl Benzene	2.25×10^5	3.38×10^6	N	6.8×10^3	N	SASS, LAB, C11	N.D.						
	Indane	2.3×10^5	3.4×10^6	N	6.8×10^3	N	SASS, LAB, LC2	7.4×10^2						
	Toluene	3.75×10^5 (100)	5.63×10^6	1.0×10^3	1.1×10^4	2.0	SASS, LAB, C8	N.D.						
	Styrene	4.2×10^5 (100)	6.3×10^6	1.0×10^3	1.3×10^4	2.0	SASS, LAB, C9	N.D.						
	Ethyl Benzene	4.35×10^5 (100)	6.53×10^6	1.0×10^3	1.3×10^4	2.0	SASS, LAB, C8	N.D.						
	Xylenes	4.35×10^5 (100)	6.53×10^6	1.0×10^3	1.3×10^4	2.0	SASS, LAB, C9	N.D.						
	4,4^1-Diphenylbiphenyl	N	N	N	N	N	SASS, LAB, LC2 & 3	1.3×10^2	N					
	Tetramethyl Benzenes	N	N	1.0×10^4	N	2.0×10	SASS, LAB, C11	N.D.						
16. HALOGENATED AROMATIC HYDROCARBONS A. RING SUBSTITUED AROMATICS	Polychlorinated biphenyls	5.0×10^2	7.5×10^3	5.0×10^{-3}			SASS, LAB, LC2 & 3	1.3×10^3	2.6	YES	1-E	1	1	1
	Polychlorinated benzenes	3.4×10^4	5.1×10^5	1.0×10^2	1.0×10^3	2.0×10^{-1}	SASS, LAB, LC2 & 3	1.3×10^3						
	Chloronaphthalenes	6.93×10^4	1.04×10^6	N	1.5×10	1.0×10^{-5}	SASS, LAB, LC2 & 3	1.3×10^3						
	2-Chlorotoluene	2.5×10^5 (50)	3.75×10^6	N	7.5×10^3	N	SASS, LAB, C9	N.D.						
	1,2-Dichlorobenzene	3.0×10^5 (50)	4.5×10^6	1.0×10^2	9.0×10^3	2.0×10^{-1}	SASS, LAB, C10	N.D.						
	Chlorobenzene	3.5×10^5 (75)	5.25×10^6	1.0×10^2	1.1×10^4	2.0×10^{-1}	SASS, LAB, C8	N.D.						
	1,4-Dichlorobenzene	4.75×10^5 (75)	6.8×10^6	1.0×10^2	1.4×10^4	2.0×10^{-1}	SASS, LAB, C10	N.D.						

TABLE KEY:

1. TEST METHOD:
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
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   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
B. AROMATICS WITH HALO-GENERATED ALKYL SIDE CHAINS	Bromo and Dibromobenzenes	N	N	N	N	N	SASS, LAB, C9, 12, & LC2	7.4×10^2	N					
	Bromochlorobenzenes	N	N	N	N	N	SASS, LAB, C12 & LC2	7.4×10^2	N					
	1,3-Dichlorobenzene	N	N	N	N	N	SASS, LAB, C10	N.D.						
	α-Chlorotoluene	5.54×10^4	8.31×10^5	1.0×10^2			SASS, LAB, C11	N.D.						
	Bis-(chloromethyl) Benzene	N	N	N	N	N	SASS, LAB, LC2	7.4×10^2						
17. AROMATIC NITRO COMPOUNDS	4-Nitrobiphenyl	1.3×10^3	2.0×10^4	N	4.0×10	N	SASS, LAB, LC4	7.4×10^2	0.32	NO				
	Dinitrotoluenes	1.50×10^3	2.25×10^4	1.0×10^3	4.5×10	2.0	SASS, LAB, LC5	2.4×10^2						
	Methoxynitrobenzene	4.5×10^3	6.75×10^4	N	1.4×10^2	N	SASS, LAB, LC5	2.4×10^2						
	Nitrobenzene	5.0×10^3 (1.0)	7.5×10^4	1.0×10^3	1.5×10^2	2.0	SASS, LAB, C12 & LC4	4.1×10^2						
	1-Chloro-2-Nitrobenzene	1.3×10^4	1.95×10^5	1.0×10^4	4.0×10^2	2.0×10	SASS, LAB, LC4	4.1×10^2						
	1-Chloro-4-Nitrobenzene	1.89×10^4	2.04×105	N	5.8×10^2	N	SASS, LAB, LC4	4.1×10^2						
	Nitrotoluenes	3.0×10^4 (5)	4.5×10^5	1.0×10^3	9.0×10^2	2.0	SASS, LAB, LC5	4.1×10^2						
18. PHENOLS A. MONOHYDRICS	2,2'-Dihydroxydiphenyls	6.75×10^3	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2	0.05	NO				
	Polyalkyl Phenols	1.49×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Phenol	1.9×10^4 (5)	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C11	N.D.						
	Cresols	2.2×10^4 (5)	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C12 & LC6	3.6×10^2						
	Phenyl Phenols	2.3×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Alkyl Cresols	2.39×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C12 & LC6	3.6×10^2						
	2-Methoxy Phenol	3.26×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Xylenols	1.3×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Ethylphenols	N	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						

*Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
4. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
B. DIHYDRICS, POLYHYDRICS	1,4-Dihydroxybenzene	2.0×10^3	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2	0.18	NO				
	Catehol	2.0×10^4 (5)	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	1,2,3-Trihydroxybenzenes	3.55×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	1,3-Dihydroxybenzene	4.5×10^4 (10)	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C10	N.D.						
C. FUSED RING HYDROXY COMPOUNDS	1-Naphthol	1.17×10^5	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	2-Naphthol	1.09×10^5	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Indanols	1.46×10^5	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Phenanthrols	N	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	Acenaphthenols	N	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	2-Hydroxyfluorene	N	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	2-Hydroxydibenzofuran	N	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
19. HALOPHENOLS	Pentachlorophenol	5.0×10^2	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2	1.6	YES	1-E	1	1	1
	Chlorinated Cresols	2.25×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC6	3.6×10^2						
	2,4-Dichlorophenol	7.0×10^3	5.0	5.0×10^2			SASS, LAB, C12	N.D.						
	2-Chlorophenol	3.02×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C10	N.D.						
20. NITROPHENOLS	Trinitrophenol	1.0×10^2 (0.011)	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2	8.2	YES	1-E	1	1	1
	Dinitro-o-cresol	2.0×10^2 (0.025)	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2						
	Dinitro-p-cresol	6.8×10^2	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2						
	Dinitrophenols	1.35×10^3	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2						
	4-Nitrophenol	1.58×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2						
	3-Nitrophenol	2.01×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C11 & LC7	8.2×10^2						
	2-Amino-4,6-Nitrophenol	4.64×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, LC7	8.2×10^2						
	2-Nitrophenol	5.8×10^4	5.0	5.0×10^2	1.0×10^{-2}	1.0	SASS, LAB, C12 & LC7	8.2×10^2						
21. FUSED AROMATIC HYDROCARBONS	Benzo(a)pyrene	2.11×10^{-2}	3.17×10^{-1}	N	6.0×10^{-2}	N	SASS, LAB, LC3	5.1×10^2	2.4×10^4	YES	1-E	1	1	1
	Dibenzo(a,h) anthracene	9.27×10^{-2}	1.39	N	3.0×10^{-3}	N	SASS, LAB, LC3	5.1×10^2						
	7,12-Dimethylbenz-(a)-anthracene	2.6×10^{-1}	3.91	N	8.0×10^{-3}	N	SASS, LAB, LC3	5.1×10^2						
	Dibenzo(a,i)pyrene	4.3×10	6.5×10^2	N	1.3	N	SASS, LAB, LC3	5.1×10^2						

*Summation of S-2-5, S-2-6, and S-2-7.

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD:
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	9,10-Dimethyl-1,1 2-benzanthracene	2.96×10	4.44×10^2	N			SASS, LAB, LC3	5.1×10^2						
	Benz(a)anthracene	4.45×10	6.72×10^2	N	1.3	N	SASS, LAB, LC3	5.1×10^2						
	Dibenzo(b,def) Chrysene	3.32×10^2	4.98×10^3	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Benzo(g,h,i) perylene	5.43×10^2	8.15×10^3	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Dibenzo(a,l)pyrene	1.08×10^3	1.62×10^3	N	3.2×10	N	SASS, LAB, LC3	5.1×10^2						
	Phenanthrene	1.59×10^3	2.39×10^4	N	4.8×10	N	SASS, LAB, LC3	5.1×10^2						
	Methylchrysenes	1.79×10^3	2.69×10^4	N	5.4×10	N	SASS, LAB, LC3	5.1×10^2						
	Chrysene	2.2×10^3	3.3×10^4	N	6.6×10	N	SASS, LAB, LC3	5.1×10^2						
	Picene	2.5×10^3	3.75×10^4	N	7.5×10	N	SASS, LAB, LC3	5.1×10^2						
	Benzo(e)pyrene	3.04×10^3	4.56×10^4	N	9.1×10	N	SASS, LAB, LC3	5.1×10^2						
	Dibenzo(a,h)pyrene	3.68×10^3	5.52×10^4	N	1.1×10^2	N	SASS, LAB, LC3	5.1×10^2						
	Dibenz(a,c) anthracene	9.9×10^3	1.5×10^5	N	3.0×10^2	N	SASS, LAB, LC3	5.1×10^2						
	1,2:3,4-Dibenzo-anthracene	1.0×10^4	1.5×10^5	N			SASS, LAB, LC3	5.1×10^2						
	Benzo(g)chrysene	1.63×10^4	2.45×10^5	N	4.8×10^2	N	SASS, LAB, LC3	5.1×10^2						
	Benzo(c)phen-anthrene	2.69×10^4	4.04×10^5	N	8.2×10^2	N	SASS, LAB, LC3	5.1×10^2						
	Methylphen-anthrenes	3.04×10^4	4.56×10^5	N	9.1×10^2	N	SASS, LAB, LC3	5.1×10^2						
	Naphthalene	5.0×10^4	7.5×10^5	1.0×10^2	1.5×10^3	$2.0 \times 10{-1}$	SASS, LAB, C11 & LC2	1.3×10^3						
	Anthracene;Methyl Anthracene	5.6×10^4	8.4×10^5	N	1.7×10^3	N	SASS, LAB, LC3	5.1×10^2						
	Monoalkyl Naphthalenes	2.25×10^5	3.38×10^6	N	6.8×10^3	N	SASS, LAB, LC2	1.3×10^3						
	Dimethyl Naphthalenes	2.25×10^5	3.38×10^6	N	6.8×10^3	N	SASS, LAB, LC2	1.3×10^3						
	Pyrene	2.33×10^5	3.5×10^6	N	6.9×10^3	N	SASS, LAB, LC3	5.1×10^2						
	Phenyl Naphtha-lenes	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Acenaphthene; Acenaphthylene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	2,7-Dimethyl-anthracene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Naphthacene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Triphenylene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOP-MENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASON-ABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) g/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	1-Methyl Pyrene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Dimethyl Pyrenes	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	1,2 Benzoaphthacene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Perylene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Coronene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
22. FUSED NON-ALTERNATE POLYCYCLIC HYDROCARBONS	3-Methyl-Cholanthrene	3.75	5.63×10	N	1.1×10^{-1}	N	SASS, LAB, LC3	5.1×10^2	1.4×10^2	YES	1-E	1	1	1
	Benzo(b) fluoranthene	8.97×10^2	1.35×10^4	N	2.8×10	N	SASS, LAB, LC3	5.1×10^2						
	Benzo(k) fluoranthene	1.63×10^3	2.45×10^4	N	4.9×10	N	SASS, LAB, LC3	5.1×10^2						
	Indeno(1,2,3,c,d) pyrene	1.63×10^3	2.45×10^4	N	4.8×10	N	SASS, LAB, LC3	5.1×10^2						
	Benzo(j) fluoranthene	6.48×10^3	9.72×10^4	N	2.0×10^2	N	SASS, LAB, LC3	5.1×10^2						
	1,2:5,6-Dibenzofluorene	1.32×10^4	1.98×10^5	N	4.0×10^2	N	SASS, LAB, LC3	5.1×10^2						
	Dicyclopentadiene	1.59×10^4	2.39×10^5	1.0×10^2	4.8×10^2	2.0×10^{-1}	SASS, LAB, LC3	5.1×10^2						
	Indane, Indene	4.5×10^4 (10)	6.75×10^5	N	N	N	SASS, LAB, C10	N.D.						
	Fluoranthene, (Tetrahydro-fluoroanthene)	9.0×10^4	1.35×10^5	N	2.8×10^3	N	SASS, LAB, C11	N.D.						
	Fluorene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Cyclopentano-naphthalene	N	N	N	N	N	SASS, LAB, LC2	1.3×10^3	N					
	2,3-Benzofluorene	N	N	N	N	N	SASS, LAB, LC2	1.3×10^3						
	1,2-Benzofluorene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Cyclopenta(def)-phenanthrene	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						
	Truxene(Tribenzylene Benzene)	N	N	N	N	N	SASS, LAB, LC3	5.1×10^2						

*Summation of S-2-5, S-2-6, and S-2-7.

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD:
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAX
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m³ (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE μg/m³ (ppm) μg/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPEC-TATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
23. HETEROCYCLIC NITROGEN														
A. PYRIDINE & SUBSTITUTED PYRIDINES	Pyridine	1.5 x 10^4 (5)	2.25 x 10^5	1.0 x 10^4	4.5 x 10^2	2.0 x 10	SASS, LAB, C8	N.D.						
	Di & polysubstituted pyridines	2.7 x 10^4	4.05 x 10^5	N	8.2 x 10^2	N	SASS, LAB, C10	N.D.						
	Picolines	3.56 x 10^4	5.34 x 10^5	N	1.1 x 10^3	N	SASS, LAB, C6	N.D.						
	Chloropyridine	4.82 x 10^3	7.23 x 10^4	N	1.4 x 10^2	N	SASS, LAB, C9 & C10	N.D.						
	Collidines	5.9 x 10^4	1.0 x 10^6	N	2.1 x 10^3	N	SASS, LAB, C8 & LC3	5.1x10^2	0.009	NO				
	Monosubstituted Alkyl Pyridines	N	N	N	N	N	SASS, LAB, LC3	5.1x10^2						
B. FUSED 6-MEMBERED RING	Dibenz(a,h) acridine	2.24 x 10^2	3.36 x 10^3	N	6.7	N	SASS, LAB, LC6	3.6x10^2	1.6	YES	1-E	1	1	1
	Dibenz(a,j) acridine	2.47 x 10^2	3.71 x 10^3	N	7.4	N	SASS, LAB, LC6	3.6x10^2						
	Benz(c)acridine	1.1 x 10^4	1.6 x 10^5	N	3.2 x 10^2	N	SASS, LAB, LC6	3.6x10^2						
	Quinoline; Isoquinoline	1.58 x 10^4	2.37 x 10^5	N	4.7 x 10^2	N	SASS, LAB, LC6	3.6x10^2						
	Dibenz(c,h) acridine	2.33 x 10^4	3.5 x 10^5	N	6.9 x 10^2	N	SASS, LAB, LC6	3.6x10^2						
	Methylquinolines	5.54 x 10^4	8.31 x 10^5	N	1.7 x 10^3	N	SASS, LAB, LC6	3.6x10^2						
	Acridine	9.0 x 10^4	1.4 x 10^6	N	2.7 x 10^3	N	SASS, LAB, LC6	3.6x10^2						
	Dimethylquinolines	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Dihydroacridine	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Benzo(c)quinolin	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Benzo(f)quinoline	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Benzo(h)quinoline	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Benzo(a)acridine	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Dibenz H-Indeno (1,2-b)quinoline	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
	Indeno (1,2,3,i,j) isoquinoline	N	N	N	N	N	SASS, LAB, LC6	3.6x10^2						
C. PYRROLE AND RING DERIVATIVES	Dibenzo(c,d) carbazole	1.05 x 10^3	1.58 x 10^3	N	3.0	N	SASS, LAB, LC6	3.6x10^2						
	Pyrrole	2.75 x 10^3	4.13 x 10^4	N	8.1 x 10	N	SASS, LAB, LC6	3.6x10^2						
	Dibenzo(a,g) carbazole	6.03 x 10^3	9.05 x 10^4	N	1.8 x 10^2	N	SASS, LAB, LC6	3.6x10^2						
	Indole	1.1 x 10^4	1.7 x 10^5	N	3.3 x 10^2	N	SASS, LAB, LC6	3.6x10^2						

*Summation of S-2-5, S-2-6, and S-2-7.

N.D. Not Detected
N N Value

TABLE KEY:

1. TEST METHOD:
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
D. NITROGEN HETEROCYCLES containing ADDN'L HETEROATOMS	Dibenzo(a,i) carbazole	1.15×10^4	1.73×10^5	N	3.6×10^2	N	SASS, LAB, LC6	3.6×10^2						
	Benzo(a) carbazole	1.89×10^4	2.84×10^5	N	5.6×10^2	N	SASS, LAB, LC6	3.6×10^2						
	Carbazole	2.25×10^4	3.38×10^5	N	6.8×10^2	N	SASS, LAB, LC6	3.6×10^2						
	Methylindoles	4.5×10^4	6.75×10^5	N	1.4 x 103	N	SASS, LAB, LC6	3.6×10^2						
	Benzothiazole	4.28×10^3	6.42×10^4	N	6.4×10^4	N	SASS, LAB, LC6	3.6×10^2						
	Methyl Benzthiazoles	4.73×10^3	7.10×10^4	N	1.4×10^2	N	SASS, LAB, LC6	3.6×10^2						
24. HETEROCYCLIC NITROGEN	Tetrahydrofuran	5.9×10^5 (200)	8.85×10^6	N	1.8×10^4	N	SASS, LAB, LC5	2.4×10^2		NO				
	Furan	N	N	N	N	N	GAS, FIELD, C5	N.D.						
	Benzofuran	N	N	N	N	N	SASS, LAB, C10	N.D.						
	Dibenzofuran	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
	Methyldibenzo-furanes	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
	Naphthofurans	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
	Benzo(b)naphto (2,3-d)furan	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
	Phenoanthro(9, 10-b)furan	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
	1-9-Benzox-anthene	N	N	N	N	N	SASS, LAB, LC5	2.4×10^2						
25. HETEROCYCLIC SULFUR	Benzonaphtho-thiopene	9.86×10^2	1.48×10^4	N	3.0×10	N	SASS, LAB, LC4	4.1×10^2	0.42	YES	1-E	1	1	1
	Thiophene	4.5×10^3	6.75×10^4	N	1.4×10^2	N	GAS, FIELD, C5	N.D.						
	Methylthiophenes	2.25×10^4	3.38×10^5	N	7.0×10^2	N	SASS, LAB, C8	N.D.						
	Benzo(b)thiophene	2.30×10^4	3.45×10^5	N	7.0×10^2	N	SASS, LAB, LC4	4.1×10^2						
	Dimethyl-thiophenes	N	N	N	N	N	SASS, LAB, C9	N.D.						
	Tri; Tetramethyl thiophenes	N	N	N	N	N	SASS, LAB, C10	N.D.						
	2,2-Bithiophene	N	N	N	N	N	SASS, LAB, LC4	4.1×10^2						
	Dibenzthiophene	N	N	N	N	N	SASS, LAB, LC4	4.1×10^2						
26. ORGANO-METALLICS A. ALKYL or ARYL	Alkyl Mercury	1.0×10 (.001)	1.5×10^2	2.0×10^{-4}	3.0×10^{-1}	4.0×10^{-5}	GAS, FIELD, C6	N.D.						
	Tetraethyl Lead	1.0×10^2 (.0075)	1.5×10^3	$<4.5 \times 10^1$			SASS, LAB, C12 and LC1	7.6×10^2	7.5	YES	1-E	1	1	1
	Organotin	1.0×10^2	1.0×10^3	N	3.0	N	GAS, FIELD,C6	N.D.						
	Tetramethyl Lead	1.5×10^2 (.014)	2.25×10^3	N	4.5	N	SASS, LAB, C7	N.D.						
	Organogermanes	3.15×10^4	4.73×10^5	N	9.4×10^2	N	GAS, FIELD, C6	N.D.						
	Trimethyl Arsine	N	N	N	N	N	GAS, FIELD, C5	N.D.						

TABLE KEY:

1. TEST METHOD:
   1. STANDARD
   2. DEVELOP-MENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASON-ABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	WHERE FOUND IN LEVEL I	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST	SAMPLE ALIQUOT[4]
B. SANDWICH TYPE	Nickelocene	3.5×10^3	5.25×10^4	N	1.0×10^2	N	SASS,LAB,LC4	4.1×10^2	0.11	NO				
	Ferrocene	5.94×10^4	8.91×10^5	N	1.8×10^3	N	GAS,FIELD,C6	N.D.						
	Dibenzene chromium	N	N	N	N	N								
C. METAL PORPHYRINS AND OTHER CHELATES	Complexed Copper	3.52×10^3	5.28×10^4	N	9.0×10	N								
	Complexed Nickel	N	N	N	N	N								
	Complexed Iron	N	N	N	N	N								
	Complexed Tin	N	N	N	N	N								
	Complexed Zinc	N	N	N	N	N								

TABLE KEY:

1. TEST METHOD:
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Summation of S-2-5, S-2-6 and S-2-7.

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPEC-TATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
27. LITHIUM	Li	2.2 x 10	3.3 x 10^2	3.8 x 10^2	7.0 x 10^{-1}	7.5 x 10^{-1}	2.3x10^2	10.5	YES	1-A	1	1	1
	Li^+	2.2 x 10	3.3 x 10^2	3.8 x 10^2									
	LiF (as Li)	2.2 x 10	3.3 x 10^2	3.8 x 10^2									
	Li_2CO_3 (as Li)	2.2 x 10	3.3 x 10^2	3.8 x 10^2									
	LiH	2.5 x 10	3.8 x 10^2	N									
28. SODIUM	Na^+	5.3 x 10^4	8.0 x 10^5	N	1.6 x 10^3	N	5.7x10^4	1.0	YES	1-A	1	1	1
	NaOH	2.0 x 10^3	3.0 x 10^4	N	6.0 x 10	N							
29. POTASSIUM	KOH	2.0 x 10^3	3.0 x 10^4	N	6.0 x 10	N	2.6x10^5		YES				
	K	N	N	N	N	N							
	K^+ (as K)	N	N	2.3 x 10^4	N	4.6 x 10							
30. RUBIDIUM	Rb^{+1}	1.21 x 10^5	1.82 x 10^6	N	3.64 x 10^3	N	1x10^2		NO				
31. CESIUM	CS^{+1}	8.19 x 10^4	1.23 x 10^6	N	2.46 x 10^3	N	1.7x10		NO				
32. BERYLLIUM	Be	2.0	3.0 x 10	5.5 x 10	6.0 x 10^{-2}	1.1 x 10^{-1}	4.1	2.0	YES	1-A	1	1	1
	Be^{++}	2.0	3.0 x 10	5.5 x 10	6.0 x 10^{-2}	1.1 x 10^{-1}							
	BeO (as Be)												
	$BeO \cdot Al_2O_3 \cdot SiO_2$ (as Be)	2.0	3.0 x 10	5.5 x 10	6.0 x 10^{-2}	1.1 x 10^{-1}							
33. MAGNESIUM	Magnesium, Mg	6.0 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2	9.8x10^4	16.3	YES	1-A	1	1	1
	Magnesium Ion, Mg^{++}	6.01 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2							
	Magnesium Oxide, MgO	1.01 x 10^4	1.5 x 10^5	1.0 x 10^5	3.0 x 10^2	2.0 x 10^2							
	Magnesium Fluoride, MgF_2 (as Mg)	6.0 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2							
	Magnesium Sulfate, $MgSO_4$ (as Mg)	6.0 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2							
	Magnesite, $MgCO_3$ (as Mg)	6.0 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2							
	Dolomite, $MgCO_3 \cdot CaCO_3$ (as Mg)	6.0 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2							
	Asbestos (as Mg)	6.0 x 10^3	9.0 x 10^4	8.7 x 10^4	1.8 x 10^2	1.7 x 10^2							
34. CALCIUM	Calcium Ion, Ca^{++}	1.6 x 10^4	2.4 x 10^5	1.6 x 10^4	4.8 x 10^2	3.2 x 10	1.3x10^6	81.0	YES	1-A	1	1	1
	Calcium Fluoride, CaF_2	N	N	N	N	N							
	Calcium Carbonate, $CaCO_3$	N	N	N	N	N							
	Calcium Sulfate, $CaSO_4$	N	N	N	N	N							
	Dolomite, $MgCO_3 \cdot CaCO_3$	N	N	N	N	N							

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOP-MENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
35. STRONTIUM	Strontium	3.1×10^3	4.6×10^4	N	9.2×10	N	4.3×10^3	1.4	YES	1-A	1	1	1
	Strontium Ion, Sr^{++} (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
	Strontium Fluoride, SrF_2 (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
	Strontium Sulfate, $SrSO_4$ (as Sr)	3.1×10^3	4.6×10^4	N	9.2×10	N							
36. BARIUM	Barium, Ba	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0	1.6×10^4	32	YES	1-A	1	1	1
	Barium Ion, Ba^{++} (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Sulfide, BaS (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Thio-carbonate, $BaCS_3$ (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Fluoride, BaF_2 (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
	Barium Carbonate, $BaCO_3$ (as Ba)	5.0×10^2	5.0×10^3	8.5×10^3	1.0×10	5.0							
	Barium Sulfate, $BaSO_4$ (as Ba)	5.0×10^2	5.0×10^3	2.5×10^3	1.0×10	5.0							
37. BORON	Boron, B	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10	1.0×10^3	0.32	NO				
	Borate, BO_3 (as B)	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10							
	Metaborate, BO_2- (as B)	3.1×10^3	4.7×10^4	2.5×10^4	9.3×10	5.0×10							
	Boron Oxide, B_2O_3	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
38. ALUMINUM	Aluminum, Al	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.01	9.4×10^5	180	YES	1-A	1	1	1
	Aluminum Ion, Al^{+++}	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	N							
	Bauxite, $Al_2O_3 \cdot 3H_2O$ (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Hydrated Aluminum Silicate (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Alums $[M\ Al\ (SO_4)_2] \cdot (H_2O)_x$ (as Al)	5.2×10^3	8.0×10^4	1.0×10^3	1.6×10^2	2.0							
	Aluminum Oxide, Al_2O_3	1.0×10^4	1.5×10^5	N	3.0×10^2	N							
39. GALLIUM	Gallium, Ga	5.0×10^3	7.4×10^4	N	1.5×10^2	N	<10		NO				
	Elemental Species, Ga	5.0×10^3	7.4×10^4	N	1.5×10^2	N							
	Gallous, Ga^{+1} (as Ga)	5.0×10^3	7.4×10^4	N	1.5×10^2	N							

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR μg/m^3 (ppm)	MATE WATER μg/l HEALTH	MATE WATER μg/l ECOLOGY	MATE LAND μg/g HEALTH	MATE LAND μg/g ECOLOGY	SAMPLE μg/m^3 (ppm) μg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Gallic, Ga^{+3} (as Ga)	5.0 x 10^3	7.4 x 10^4	N	1.5 x 10^2	N	<30		NO				
	Gallium Sesquioxide, Ga$_2$O$_3$ (as Ga)	5.0 x 10^3	7.4 x 10^4	N	1.5 x 10^2	N							
40. INDIUM	Indium, In	1.0 x 10^2	1.5 x 10^3	N	3.0	N	<20		NO				
	Indium Ion, In^{+3}	1.0 x 10^2	1.5 x 10^3	N	3.0	N							
41. THALLIUM	Thallium, Tl	1.0 x 10^2	1.5 x 10^3	N	3.0	N	1.6x10^2	1.6	YES	1-A	1	1	1
	Thallous, Tl^{+1}	1.0 x 10^2	1.5 x 10^3	N	3.0	N							
	Thallic, Tl^{+3}	1.0 x 10^2	1.5 x 10^3	N	3.0	N							
42. CARBON	Elemental Carbon	3.5 x 10^3	5.3 x 10^4	N	1.6 x 10^2	N	N.D.						
	Coal	N	N	N	N	N							
	Carbide, C-	N	N	N	N	N							
	Carbonate, CO$_3^{-2}$	N	N	N	N	N							
	Bicarbonate, HCO$_3$	N	N	N	N	N							
	Carbonyl, CO=	N	N	N	N	N							
	Carbon Monoxide	4.0 x 10^3 (35)	6.0 x 10^5	6.0 x 10	N/A	N/A							
	Carbon Dioxide	9.0 x 10^6 (5000)	N	N	N/A	N/A							
43. SILICON	Silane, SiH$_4$	7.0 x 10^2	1.1 x 10^4	N	N	2.4 x 10	N.D.						
	Silicon, Si	1.0 x 10^4	1.5 x 10^5	N	3.0 x 10^2	N	3.5x10^6	350	YES	1-A	1	1	1
	Orthosilicate, SiO$_4^{-2}$	N	N	N	N	N							
	Metasilicate, SiO$_3^{-2}$	N	N	N	N	N							
	Silicon Dioxide, SiO$_2$	1.0 x 10^4	1.5 x 10^5	N	3.0 x 10^2	N							
	Silicon Disulfide, SiS$_2$	N	N	N	N	N							
	Silicon Carbide, SiC	1.0 x 10^4	1.5 x 10^5	N	3.0 x 10^2	N							
44. GERMANIUM	Germanium, Ge	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N	8.2x10		NO				
	Germanous, Ge^{+2} (as Ge)	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N							
	Germanic, Ge^{+4} (as Ge)	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N							
	Germanous Sulfide, GeS (as Ge)	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N							
	Germanic Sulfice, GeS$_2$ (as Ge)	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N							
	Germane, GeH$_4$ (as Ge)	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N							
	Germanium Oxide, GeO$_2$ (as Ge)	5.6 x 10^2	8.4 x 10^3	N	1.7 x 10	N							

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
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   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m^3 (ppm) µg/l	RATIO $\frac{\text{SAMPLE}}{\text{MATE}}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPEC-TATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
45. TIN	Tin Oxide, SnO_2	1.0×10^4	1.5×10^5	N	3.0	N	1.9×10^2	0.02	NO				
	Tin, Sn	N	N	N	N	N							
	Stannous, Sn^{+2}	N	N	N	N	N							
	Stannic, Sn^{+4}	N	N	N	N	N							
46. LEAD	Lead, Pb	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	9.5×10^2	63	YES	1-A	1	1	1
	Elemental Led, Pb	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Plumbous, Pb^{+2}	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Plumbic, Pb^{+4} (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Monoxide, PbO (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Sulfate, $PbSO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Sulfate, Pbs (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Carbonate, $PbCO_3$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Phosphate, $Pb_3(PO_4)2$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Chromate, $PbCrO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Molybdate, $PbMoO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Lead Arsenate, $PbHAsO_4$ (as Pb)	1.5×10^2	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
47. NITROGEN	Hydrazine	1.5×10^2 (.1)	2.3	N	4.5	N	N.D.						
	Alkali Cyanides, NaCN, KCN	5.0×10^3	5.0×10^2	2.5×10	1.0	5.0×10^{-2}							
	Nitric Acid, HNO_3	5.0×10^3	7.5×10^4	4.5×10^2	1.5×10^3	9.0×10^{-1}							
	Nitrogen Oxides, N_2O, NO_2, N_2O_4, N_2O_3, N_2O_5	9.0×10^3	1.4×10^5	N	N/A	N/A							
	Hydrogen Cyanide, HCN	1.1×10^4 (10)	5.0×10^2	2.5×10	1.0	5.0×10^{-2}							
	Ammonia, NH_3	1.8×10^4 (25)	2.5×10^3	5.0×10	5.0	1.0×10^{-1}	1.8×10^5	10	YES^1	1-C	1	1	1
	Cyanogen, C_2N_2	2.0×10^4	1.0×10^3	2.5×10	2.0	5.0×10^{-2}							
	Nitride, N=	N	N	N	N	N							
	Nitrate, NO_3-	N	N	N	N	N							
	Nitrite, NO_2-	N	N	N	N	N							
	Ammonium, NH_4^+	N	N	N	N	N							

TABLE KEY:

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   3. UNKNOWN

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   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value
1. As Anionic Species

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
48. PHOSPHORUS	Phosphorus, P	1.0 x 10^2	1.5 x 10^4	5.0 x 10^{-1}	3.0 x 10	1.0 x 10-3	1.1x10^3	11	YES	1-C	1	1	1
	Phosphite, PO_3^{-3} (as P)	1.0 x 10^2	1.5 x 10^4	5.0 x 10^{-1}	3.0 x 10	1.0 x 10-3							
	Biphosphate, $H_2PO_4^-$ (as P)	1.0 x 10^2	1.5 x 10^4	5.0 x 10^{-1}	3.0 x 10	1.0 x 10^{-3}							
	Phosphine, PH_3	4.0 x 10^2 (0.3)	6.0 x 10^3	N	N/A	N/A							
	Phosphoric Acid, H_3PO_4	1.0 x 10^3	1.5 x 10^4	4.5 x 10^3	3.0 x 10	9.0							
	Phosphorus Pentasulfide	1.0 x 10^3	1.5 x 10^4	N	3.0 x 10	N							
	Phosphate, PO_4^{-3}	N	N	N	N	N							
49. ARSENIC	Arsenic, As	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}	2.3x10	1.1	YES	1-A	1	1	1
	Metallic Arsenic	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsenous, As^{+3}	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsenic, As^{+5}	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsenate, AsO_4^{-3} (as As)	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsenite, AsO_3^{-3} (as As)	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsenide, As^{-3} (as As)	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsine, AsH_3	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
	Arsenic Trioxide, As_2O_3	2.0 x 10	2.5 x 10^2	5.0 x 10^1	5.0 x 10^{-1}	1.0 x 10^{-1}							
50. ANTIMONY	Antimony Trioxide, Sb_2O_3	5.0 x 10^1	7.5 x 10^2	2.0 x 10^2 (as Sb)	1.5 x 10	4.0 x 10^{-1} (as Sb)	5.2	0.1	NO				
	Antimony Metal, Sb	5.0 x 10^2	7.5 x 10^3	2.0 x 10^2	1.5 x 10^1	4.0 x 10^{-1}							
	Antimonous, (stibnous) Sb^{+3}	5.0 x 10^2	7.5 x 10^3	2.0 x 10^2	1.5 x 10^1	4.0 x 10^{-1}							
	Antimonic (stibnic) Sb^{+5}	5.0 x 10^2	7.5 x 10^3	2.0 x 10^2	1.5 x 10^1	4.0 x 10^{-1}							
	Stibine, SbH_3 (as Sb)	5.0 x 10^2	7.5 x 10^3	2.0 x 10^2	1.5 x 10^1	4.0 x 10^{-1}							
	Antimonous Sulfide, Sb_2S_3	5.0 x 10^2	7.5 x 10^3	2.0 x 10^2	1.5 x 10^1	4.0 x 10^{-1}							
	Antimony, Sb	5.0 x 10^2	7.5 x 10^3	2.0 x 10^2	1.5 x 10^1	4.0 x 10^{-1}							
51. BISMUTH	Bismuth, Bi	4.1 x 10^2	6.1 x 10^3	N	1.2 x 10^1	N	1.7x10	0.4	NO				
	Elemental Bismuth, Bi	4.1 x 10^2	6.1 x 10^3	N	1.2 x 10^1	N							
	Bismuthous, Bi^{+3} (as Bi)	4.1 x 10^2	6.1 x 10^3	N	1.2 x 10^1	N							
	Bismuthic, Bi^{+5} (as Bi)	4.1 x 10^2	6.1 x 10^3	N	1.2 x 10^1	N							

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GS/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPECTATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
52. OXYGEN	Ozone, O_3	2.0×10^{2} (0.1)	N/A	N/A	N/A	N/A	N.D.						
53. SULFUR	Rhombic Sulfur, S_8	N	N	N	N	N	2.2×10^{4}	N					
	Sulfide, S^{-2}	N	N	N	N	N							
	Sulfate, SO_4^{-2}	N	N	N	N	N							
	Sulfite, SO_3^{-2}	N	N	N	N	N							
	Thiocyanate, SCN^-	N	N	N	N	N							
	Sulfur Trioxide, SO_3	N	N	N	N	N							
	Sulfuric Acid, H_2SO_4	1.0×10^{3}	1.5×10^{4}	4.5×10^{2}	3.0×10^{1}	9.0×10^{2}	N.D.						
	Sulfur Dioxides, SO_2	1.3×10^{4}	2.0×10^{5}	N	4.0×10^{2}	N	N.D.						
	Hydrogen Sulfide, H_2S	1.5×10^{4} (10)	2.3×10^{4}	1.0×10^{1}	N/A	N/A	N.D.						
	Carbon Disulfide, CS_2	6.0×10^{4} (20)	9.0×10^{5}	1.0×10^{4}	N/A	N/A	N.D.						
	Carbonyl Sulfide, COS	4.4×10^{5}	N/A	N/A	N/A	N/A	N.D.						
54. SELENIUM	Selenium, Se	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}	7.5	0.04	NO				
	Elemental Selenium, Se	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenide, Se^{-2}	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenites, SeO_3^{-2} (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenates, SeO_4^{-2} (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Hydrogen Selenide, H_2Se	2.0×10^{2} (.05)	5.0×10^{1} (as Se)	2.5×10^{1} (as Se)	1.0×10^{-1} (as Se)	5.0×10^{-2} (as Se)							
	Carbon Diselenide, CSe_2 (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
	Selenium Dioxide, SeO_2 (as Se)	2.0×10^{2}	5.0×10^{1}	2.5×10^{1}	1.0×10^{-1}	5.0×10^{-2}							
55. TELLURIUM	Tellurium, Te	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N	<5.5		NO				
	Telluride, Te^{-2}	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N							
	Tellurite, TeO_3^{-2} (as Te)	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N							
	Tellurate, TeO_4 (as Te)	1.0×10^{2}	1.5×10^{3}	N	3.0×10	N							
56. FLUORIDE	Fluoride Ion, F^-	2.5×10^{3}	3.8×10^{4}	N	7.5×10^{1}	N	N.D.						
	Hydrogen Fluoride, HF	2.0×10^{3}	3.0×10^{4}	N	N/A	NA	N.D.						

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
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   3. UNKNOWN

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2. EXPECTED TEST SUCCESS
   1. HIGH
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   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
57. CHLORINE	Chloride Ion, Cl^-	N	1.3×10^6	N	2.6×10^3	N	1.6×10^4	N					
	Hypochlorite, ClO^-	N	N	N	N	N							
	Chlorite, ClO_2^-	N	N	N	N	N							
	Chlorate, ClO_3	N	N	N	N	N							
	Chlorine Dioxide, ClO_2	N	N	N	N	N							
	Carbonyl Chloride (phosgene), $COCl_2$	4.0×10^2	6.0×10^3	N	N/A	N/A	N.D.						
	Hydrogen Chloride, HCl	2.0×10^3	1.1×10^5	N	N/A	N/A	N.D.						
58. BROMINE	Bromide Ion, Br^-	N	N	N	N	N	10.6	N					
	Bromide Ion, Br^-	N	N	N	N	N							
	Hydrogen Bromide, HBr	1.0×10^4	1.5×10^5	N	N/A	N/A	N.D.						
59. IODINE	Iodide Ion, I^-	N	N	N	N	N	1.1×10	N					
60. SCANDIUM	Scandium, Sc	5.3×10^4	8.0×10	N	1.6×10^{-2}	N	5.6×10^2						
	Scandium Ion, Sc^{+3}	5.3×10^4	8.0×10	N	1.6×10^{-2}	N							
61. YTTRIUM	Yttrium Ion,, Y^{+3}	1.0×10^3	1.5×10^4	N	3.0×10^1	N	8.5×10^3	0.85	YES	1-C	2	1	2
62. TITANIUM	Titanium, Ti	6.0×10^3	9.0×10^4	8.2×10^2 (as $Ti[SO_4]_2$)	1.8×10^2	1.6×10	2.7×10^4	4.5	YES	1-C	1	1	1
	Titanous, Ti^{+3} (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
	Titanic, Ti^{+4} (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
	Titanium Dioxide, TiO_2 (as Ti)	6.0×10^3	9.0×10^4	8.2×10^2	1.8×10^2	1.6×10							
63. ZIRCONIUM	Zirconium Ion, Zr^{+4}	5.0×10^3	7.5×10^4	N	1.5×10^1	N	3.5×10^3	0.7	YES	1-C	1	1	2
	Zirconium Dioxide, ZrO_2 (as Zr)	5.0×10^3	7.5×10^4	N	1.5×10^1	N							
64. HAFNIUM	Hafnium Ion, Hf^{+4}	5.0×10^2	7.5×10^4	N	1.5×10	N	3.6×10		NO				
65. VANADIUM	Vanadium, V	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}	9.8×10^3	19.6	YES	1-A	1	1	1
	Elemental Vanadium, V	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadic, V^{+3} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadyl, Vo^{+2} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Orthovanadate, VO_4^{-4} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							

*Summation of S-2-5, S-2-6, and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m³ (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m³ (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD¹	TEST EXPEC-TATIONS²	TEST COST³	SAMPLE ALIQUOT⁴
	Metavanadate, VO_3^- (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadylic, VO^{+3} (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Monoxide, VO (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Trioxide, V_2O_3 (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Tetraoxide, V_2O_4, (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Pentoxide, V_2O_5 (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Carbide, VC (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Monosulfide, VS (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadium Nitride, VN (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
	Vanadyl Sulfate, $VOSO_4 \cdot 5H_2O$ (as V)	5.0×10^2	2.5×10^3	1.5×10^2	5.0×10	3.0×10^{-1}							
66. NIOBIUM	Niobus, Nb^{+3}	2.2×10^4	3.3×10^5	N	6.5×10^2	N	8.6x10		NO				
	Niobic, Nb^{+5}	2.2×10^4	3.3×10^5	N	6.5×10^2	N							
	Niobium Oxides, NbO, Nb_2O_5 (as Nb)	2.2×10^4	3.3×10^3	N	6.5×10^2	N							
67. TANTALUM	Tantalum Ion, Ta^{+5}	5.0×10^3	7.5×10^4	N	1.5×10^2	N	3.7x10		NO				
68. CHROMIUM	Chromium, Cr	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	2.1×10^3	210	YES	1-C	1	1	1
	Chromous, Cr^{+2} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromic, Cr^{+3} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromates, CrO_4^{-2} (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromites, $Cr_2O_4^{-2}$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Dichromates, $Cr_2O_7^{-2}$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromium Carbonyl, $Cr(CO)_6$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}	N.D.						
	Chromium Sulfide, Cr_2S_3	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromic Oxide, Cr_2O_3 (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Chromite Mineral, FeO Cr_2O_3 (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							

*Summation of S-2-5, S-2-6, and S-2-7

N.D. Not Determined
N No Value

TABLE KEY

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   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm)^2 $\mu g/l$	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Hydrous Chromium Phosphate, $CrPO_4$ XH_2O (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
	Iron Chromate, $FeCrO_4$ (as Cr)	1.0×10	2.5×10^2	2.5×10^2	5.0×10^{-1}	5.0×10^{-1}							
69. MOLYBDEN	Molybdenum, Mo	5.0×10^3	7.5×10^4	7.0×10^3	1.5×10^2	1.4×10^1	3.7×10^2	0.07	NO				
	Molybdenous, Mo^{+2}	5.0×10^3	7.5×10^4	7.0×10^3	1.5×10^2	1.4×10^1							
	Molybdic, Mo^{+3}	5.0×10^3	7.5×10^4	7.0×10^3	1.5×10^2	1.4×10^1							
	Molybdate, MoO_4^{-2} (as Mo)	5.0×10^3	7.5×10^4	7.0×10^3	1.5×10^2	1.4×10^1							
	Molybdenum Sulfide, MoS_2 (as Mo)	5.0×10^3	7.5×10^4	7.0×10^3	1.5×10^2	1.4×10^1							
	Molybdenum Trioxide, MoO_3 (as Mo)	5.0×10^3	7.5×10^4	7.0×10^3	1.5×10^2	1.4×10^1							
70. TUNGSTEN	Tungsten, W	1.0×10^3	1.5×10^4	N	3.0×10^1	N	1×10		NO				
	Tungsten Ions, W^{+2}, W^{+4}, W^{+5}, W^{+6}, WO_4^{-2}	N	N	N	N	N							
	Tungsten Disulfide, WS_2 (as W)	1.0×10^3	1.5×10^4	N	3.0×10^1	N							
	Wolframite Mineral, $FeWO_4 \cdot MnWO_4$ (as W)	1.0×10^3	1.5×10^4	N	3.0×10^1	N							
71. MANGANESE	Manganese, Mn	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}	3.8×10^3	6.76	YES	1-A	1	1	1
	Manganous, Mn^{+2}	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Manganic, Mn^{+3}	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Permanganate, MnO_4^- (as Mn)	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Manganous Oxide, MnO (as Mn)	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Manganese Dioxide, MnO_2 (as Mn)	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Manganese Carbonate, $McCO_3$ (as Mn)	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Manganous Sulfate, $MnSO_4$ (as Mn)	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
	Manganese Sulfide, MnS_2 (as Mn)	5.0×10^3	2.5×10^2	1.0×10^2	5.0×10^{-1}	2.0×10^{-1}							
72. IRON	Iron Carbonyls, $Fe(CO)_5$, $Fe(CO)_9$, $FE_3(CO)_{12}$	7.0×10^2	1.1×10^4	N	2.1×10^1	N	N.D.						
	Ferrous, Fe^{+2}	1.0×10^3	1.5×10^3	2.5×10^2	3.0×10	5.0×10^{-1}	4.3×10^5	456	YES	1-A	1	1	1
	Ferric, Fe^{+3}	1.0×10^3	1.5×10^3	2.5×10^2	3.0×10	5.0×10^{-1}							
	Ferrous Oxide, FeO	5.0×10^3	7.5×10^4	N	1.5×10^2	N							

*Summation of S-2-5, S-2-6, and S-2-7

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   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m^3 (ppm) µg/l	RATIO SAMPLE/MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD^1	TEST EXPEC-TATIONS^2	TEST COST^3	SAMPLE ALIQUOT^4
	Magnetite, $FeO \cdot Fe_2O_3$	9.3×10^3	6.2×10^3	N	3.8×10^1	N							
	Ferrocyanide, $Fe(CN)_6^{-4}$	N	N	N	N	N							
	Ferricyanide, $Fe(CN)_6^{-3}$	N	N	N	N	N							
	Ferric Oxide, Fe_2O_3	N	N	N	N	N							
	Ferric Hydroxide (hydrated) $Fe_2O_3 \cdot XH_2O$	N	N	N	N	N							
	Iron Sulfides, FeS, Fe_2S_3	N	N	N	N	N							
	Pyrite, FeS_2	N	N	$>1.0 \times 10^5$	N	2.0×10^2							
	Potassium Iron Silicate, $KFeSi_2O_6$	N	N	N	N	N							
73. RUTHENIUM	Ruthenium Ion, Ru^{+3}	N	N	N	N	N	<9	N					
74. COBALT	Cobalt, Co	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}	1.9×10^2	3.8	YES	1-C	1	1	1
	Cobaltous, Co^{+2}	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltic, Co^{+3}	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltous Carbonate, hydrated, $CoCO_3 \cdot H_2O$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Carbide, Co_3C (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Sulfides, CoS, Co_2S_3 (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Arsenic Sulfide, CoAsS (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Arsenide, $CoAs_2$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobalt Carbonyl, $Co(CO)_4$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}	N.D.						
	Cobaltous Oxide, CoO (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
	Cobaltous Hydroxide, $Co(OH)_2$ (as Co)	5.0×10^1	7.5×10^2	2.5×10^2	1.5×10	5.0×10^{-1}							
75. RHODIUM	Rhodium Ion, Rh^{+3}	1.0×10	1.5×10^1	N	3.0×10^{-2}	N	2.1×10^2	21	YES	1-C	1	1	1
76. NICKEL	Nickelous, Ni^{+2}	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}	3.8×10^3	250	YES	1-A	1	1	1
	Nickelic, Ni^{+3}	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickelous Sulfide, NiS (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Arsenide, NiAs (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Continued)

CATEGORY	COMPOUND	MATE AIR $\mu g/m^3$ (ppm)	MATE WATER $\mu g/l$ HEALTH	MATE WATER $\mu g/l$ ECOLOGY	MATE LAND $\mu g/g$ HEALTH	MATE LAND $\mu g/g$ ECOLOGY	SAMPLE $\mu g/m^3$ (ppm) $\mu g/l$	RATIO $\frac{SAMPLE}{MATE}$	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPEC-TATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Nickel Oxide, NiO (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Antimonide, NiSb (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Arsenic Sulfide, NiAsS (as Ni)	1.5×10^1	2.3×10^2	1.0×10^1	4.5×10^{-1}	2.0×10^{-2}							
	Nickel Carbonyl, $Ni(CO)_4$	4.3×10^1	6.5×10^2	1.0×10^1 (as Ni)	1.0×10	2.0×10^{-3}	N.D.						
77. PLATINUM	Elemental Platinum, Pt	2.0×10	3.0×10^1	N	6.0×10^{-2}	N	<5		NO				
78. COPPER	Copper	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}	9.7×10^2	4.9	YES	1-A	1	1	1
	Cuprous, Cu^+	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Cupric, Cu^{+2}	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Copper Fluoride, CuF_2 (as Cu)	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Copper Oxides, CuO, Cu_2O (as Cu)	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-5}							
	Copper Sulfate, $CuSO_4$ (as Cu)	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Copper Sulfides, CuS, Cu_2S (as Cu)	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Copper Carbonate, $CuCO_3$ (as Cu)	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Malachite Mineral, $CuCO_3 \cdot Cu(OH)_2$ (as Cu)	2.0×10^2	5.0×10^3	5.0×10^1	1.0×10^1	1.0×10^{-1}							
	Chalcopyrite Mineral, $CuFeS_2$	N	N	N	N	N							
79. SILVER	Silver, Ag	1.0×10^1	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	<1	N					
	Silver Ion, Ag^+ (as Ag)	1.0×10^1	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}	$< 5 \times 10$		NO				
	Silver Chloride, AgCl (as Ag)	1.0×10^1	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Cyanide, AgCN (as Ag)	1.0×10^1	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
	Silver Sulfide, Ag_2S (as Ag)	1.0×10^1	2.5×10^2	5.0×10	5.0×10^{-1}	1.0×10^{-1}							
80. GOLD	Elemental Gold	N	N	N	N	N							
81. ZINC	Zinc, Zn	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}							
	Elemental Zinc, Zn	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}							
	Zinc Ion, Zn^{+2}	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}							
	Zinc Oxide, ZnO (as Zn)	4.0×10^3	2.5×10^4	1.0×10^2	5.0×10^1	2.0×10^{-1}							

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

Table 2-2. Total Emission Data From 6-inch FBC Unit* (Concluded)

CATEGORY	COMPOUND	MATE AIR µg/m^3 (ppm)	MATE WATER µg/l HEALTH	MATE WATER µg/l ECOLOGY	MATE LAND µg/g HEALTH	MATE LAND µg/g ECOLOGY	SAMPLE µg/m^3 (ppm) µg/l	RATIO SAMPLE / MATE	LEVEL 2 REQUIRED Y=YES N=NO	TEST METHOD[1]	TEST EXPECTATIONS[2]	TEST COST[3]	SAMPLE ALIQUOT[4]
	Zinc Sulfate, $ZnSO_4$ (as Zn)	4.0 x 10^3	2.5 x 10^4	1.0 x 10^2	5.0 x 10^1	2.0 x 10^{-1}							
	Zinc Sulfide, ZnS (as Zn)	4.0 x 10^3	2.5 x 10^4	1.0 x 10^2	5.0 x 10^1	2.0 x 10^{-1}							
82. CADMIUM	Cadmium, Cd	1.0 x 10^1	5.0 x 10^1	1.0 x 10	1.0 x 10^{-1}	2.0 x 10^{-3}	<6 x 10	6	YES	1-A	1	1	1
	Elemental Cadmium, Cd	1.0 x 10^1	5.0 x 10^1	1.0 x 10	1.0 x 10^{-1}	2.0 x 10^{-3}							
	Cadmium Ion, Cd^{+2}	1.0 x 10^1	5.0 x 10^1	1.0 x 10	1.0 x 10^{-1}	2.0 x 10^{-3}							
	Cadmium Sulfide, CdS (as Cd)	1.0 x 10^1	5.0 x 10^1	1.0 x 10	1.0 x 10^{-1}	2.0 x 10^{-3}							
	Cadmium Oxide, CdO (as Cd)	1.0 x 10^1	5.0 x 10^1	1.0 x 10	1.0 x 10^{-1}	2.0 x 10^{-3}							
83. MERCURY	Mercury, Hg	5.0 x 10^1	1.0 x 10^1	2.5 x 10^2	2.0 x 10^{-2}	5.0 x 10^{-1}	1 x 10	0.2	NO				
	Elemental Mercury, Hg	5.0 x 10^1	1.0 x 10^1	2.5 x 10^2	2.0 x 10^{-2}	5.0 x 10^{-1}							
	Mercurous, Hg_2^{++}	5.0 x 10^1	1.0 x 10^1	2.5 x 10^2	2.0 x 10^{-2}	5.0 x 10^{-1}							
	Mercuric, Hg^{++}	5.0 x 10^1	1.0 x 10^1	2.5 x 10^2	2.0 x 10^{-2}	5.0 x 10^{-1}							
	Mercuric Sulfide, HgS	5.0 x 10^1	1.0 x 10^1	2.5 x 10^2	2.0 x 10^{-2}	5.0 x 10^{-1}							
	Mercuric Chloride, $HgCl_2$	5.0 x 10^1	1.0 x 10^1	2.5 x 10^2	2.0 x 10^{-2}	5.0 x 10^{-1}							
84. CERIUM	Dysprosium, Dy (Dy^{+3})	9.3 x 10^3	2.3 x 10^5	N	4.6 x 10^2	N							
	Cerium, Ce (Ce^{+3}, Ce^{+4}, Ce_2O_3)	3.7 x 10^4	5.5 x 10^5	N	1.1 x 10^3	N	1.6x10^3	0.04	NO				
	Praseodymium, Pr (Pr^{+3})	5.1 x 10^4	7.7 x 10^5	N	1.5 x 10^3	N							
	Samarium, Sm (Sm^{+3})	5.3 x 10^4	7.9 x 10^5	N	1.6 x 10^3	N							
	Lanthanum, La	1.1 x 10^5	1.7 x 10^6	N	3.4 x 10^3	N							
	Neodymium, Nd (Nd^{+3})	N	N	N	N	N							
85. URANIUM	Uranium, U (U^{+6})	9.0 x 10	6.0 x 10^4	5,0 x 10^2	1.2 x 102	1.0 x 10	6.4x10	0.7	YES	1-C	1	1	1
86. THORIUM	Thorium, Th (Th^{+4})	4.2 x 10^2	6.3 x 10^3	N	1.3 x 10	N	1.6x10^2	0.39	YES	1-C	1	1	1

TABLE KEY:

1. TEST METHOD
   1. STANDARD
   2. DEVELOPMENTAL
   3. UNKNOWN

   A. AAS
   B. XRD
   C. WET CHEMICAL
   D. ESCA
   E. GC/MS
2. EXPECTED TEST SUCCESS:
   1. HIGH
   2. MODERATE
   3. UNKNOWN
3. TEST COST
   1. REASONABLE
   2. MODERATE
   3. HIGH
4. SAMPLE ALIQUOT
   1. ADEQUATE
   2. MARGINAL
   3. INADEQUATE
   4. RESAMPLE

*Summation of S-2-5, S-2-6 and S-2-7

N.D. Not Determined
N No Value

Table 3-3. Atomic Absorption Analytical Operating Parameters

Element	Analytical Wavelength, Å	Background Wavelength, Å	Slit Width, Å	Atomization Source	Analytical Procedure
Ag	3281	3235 (Ne)	10	G.F.*	Dry – 30 sec. @ 200°C Ash – 60 sec. @ 400°C Atomize – 7 sec. @ 2300°C – Argon Gas
Cu	3247	None	10	G.F.*	Dry – 30 sec. @ 200°C Ash – 60 sec. @ 600°C Atomize – 6 sec. @ 2500° C – Argon Gas
Ni	2320	2316	4	G.F.*	Dry – 20 sec. @ 200°C Ash – 30 sec. @ 800°C Atomize – 6 sec. @ 2800°C – Argon Gas
Li	6708	None	2	Air-C_2H_2	Atomic Emission
Mg	2852	None	4	Air-C_2H_2	Atomic Absorption
Pb	2833	2825	4	G.F.*	Dry – 40 sec. @ 200°C Ash – 40 sec. @ 600°C Atomize – 6 sec. @ 1900°C 10 µl 1.0% HNO_3 & 0.2% $(NH_4)_6Mo_7O_{24}$ added in furnace
Zn	2139	None	4	Air-C_2H_2	Atomic Absorption
Cd	2288	None	4	Air-C_2H_2	Atomic Absorption
Be	2349	None	4	N_2O-C_2H_2	Atomic Absorption
Cr	3579	None	4	Air-C_2H_2	Atomic Absorption
Pt	2659	Continuum	4	G.F.*	Dry – 30 sec. @ 300°C Ash – 30 sec. @ 1150°C Atomize – 5 sec. @ 2700°C – Argon Gas
V	3185	3196	2	G.F.*	Dry – 30 sec. @ 200°C Ash – 40 sec. @ 1000°C Atomize – 5 sec. @ 2800°C – Argon Gas
Si	2516	None	2	N_2O-C_2H_2	Atomic Absorption
Sr	4607	None	2	Air-C_2H_2	Atomic Emission

---

*Graphite furnace.

Table 3-4. Atomic Absorption Particulate Analysis (μg/g) Results

		Elements										
Sample #	Weight (g)	Li	Ag[1]	Cr	Mg	Zn	Cd	Be	Pb	V	Si	Sr
S-2-3	0.0623	13	12	76	5,950	N.D.	8.0	N.D.	52	48	<4,020	1092
S-2-4	0.0638	26	N.D.	204	10,552	N.D.	15.7	N.D.	314	180	4,700	N.D.
S-2-5	0.0677	72	N.D.	316	5,365	N.D.	<4	N.D.	<4	370	111,000	N.D.
S-2-6	0.0957	31	21	418	3,456	360	<3	<5	167	104	679,000	762
S-2-7-2	0.0163	74	N.D.	756	7,779	N.D.	31	N.D.	1,194	491	178,000	N.D.
S-2-7-3	0.0138	76	N.D.	538	6,884	N.D.	<18	N.D.	58	580	138,000	N.D.

[1] Blank value higher than samples. Values reported not corrected for any blank.

N.D. — not determined. Based on MATE values these elements were not required in the Level 2 effort.

Table 3-5. Atomic Absorption Leachate Solution Analysis (mg/l) Result

Solution	Elements											
Acidic	Zn	Ag	Li	V	Pb	Cu	Ni	Hg	Be	Pt	Si	Sr
NBS-A	N.D. < 0.005	N.D. <0.0005	0.095	0.08	N.D. <0.02	N.D. <0.01	N.D. <0.01	0.0003	N.D. <0.01	N.D. <0.05	75	0.70
S-2-1-A	N.D. < 0.005	0.0014	0.007	0.14	0.24	N.D. <0.01	0.03	N.D. <0.0002	N.D. <0.01	N.D. <0.05	74	N.D. <0.02
S-2-2-A	0.020	N.D. <0.0005	N.D. <0.002	0.05	0.05	N.D. <0.01	N.D. <0.01	0.0002	N.D. <0.01	0.15	34	N.D. <0.02
S-2-3-A	0.22	0.0041	0.035	N.D. <0.02	0.22	N.D. <0.01	N.D. <0.01	N.D. <0.0002	N.D. <0.01	N.D. <0.05	260	1.67
S-2-6-A	N.D. <0.005	N.D. <0.0005	0.043	0.05	0.10	N.D. <0.01	N.D. <0.01	N.D. <0.0002	0.02	N.D. <0.05	300	0.28
Basic												
NBS-B	0.046	N.D. <0.0005	0.092	N.D. <0.02	N.D. <0.02	N.D. <0.01	N.D. <0.01	N.D. <0.0002	N.D. <0.01	N.D. <0.05	71	0.40
S-2-1-B	0.071	0.0005	0.005	0.08	0.49	N.D. <0.01	0.04	N.D. <0.0002	N.D. <0.01	N.D. <0.05	12	0.60
S-2-2-B	N.D. <0.005	0.0009	0.006	N.D. <0.02	N.D. <0.02	N.D. <0.01	N.D. <0.01	N.D. <0.0002	N.D. <0.01	N.D. <0.05	144	N.D. <0.02
S-2-3-B	N.D. <0.005	N.D. <0.0005	0.023	N.D. <0.02	0.010	N.D. <0.01	N.D. <0.01	N.D. <0.0002	N.D. <0.01	N.D. <0.05	N.D. <5	2.19
S-2-6-B	N.D. <0.005	N.D. <0.0005	0.026	N.D. <0.02	N.D. <0.002	N.D. <0.01	N.D. <0.01	N.D. <0.0002	--	N.D. <0.05	N.D. <5	0.55

N.D. Not Detected.

Table 3-6. Percent Recovery of Spiked Samples by Atomic Absorption

Element	Solutions		
	Leachates		
	Acid	Basic	Particulate
Zn	104	105	-
Mg	-	-	95
Ag	80	80	78
Ni	60	110	-
Li	104	103	-
Cu	80	80	-
Cd	-	-	110
Be	100	100	100
Cr	-	-	84
Pb	105, 97	93	130, 84
Pt	100	64	-
V	113	107	116
Si	96	122	107
Hg	100	100	102
Sr	75	80	106

Table 3-8. ICPOES Recovery Results

	Fe	K	Mg	Mn	Al	B	Ba	Ca	Cu	Cd	Co	Cr	Mo	Ni	Average Recovery
Acidic Leachates	94.05	98.4	94.0	93.0	94.9	100.3	103.0	96.5	94.5	91.1	96.6	97.7	94.5	97.2	96.1
Basic Leachates	74.1*	102.0	95.2	94.3	95.1	94.0	112.0	104.3	97.4	96.7	96.3	92.7	94.2	105.1	96.7

*$Fe(OH)_3$ was observed as a precipitate.

The following photomicrographs were pictured in the report:

FBC samples S-2-4 and S-2-5

Representative Appearance of FBC Sample S-2-6 (42x)

Representative Appearance of and Unusually Large Yellow Particle Seen in Sample S-2-7

Size Variation of Agglomerates Observed in Sample S-2-7.

The following SEM photomicrographs were pictured in the document:

SEM at 3000X of Sample S-2-3

SEM at 3000X of Sample S-2-5

SEM at 3000X and 6000X of Sample S-2-7

SEM at 3000X of Sample S-2-4

SEM at 3000X of Sample S-2-6

The following EPMA photomicrographs were pictured in the document:

EPMA of Sample S-2-3

EPMA of Sample S-2-5

EPMA of Sample S-2-7

TEM/SAED Analysis of Sample S-2-4

TEM/SAED Analysis of S-2-6

EPMA of Sample S-2-4

EPMA of Sample S-2-6

TEM/SAED Analysis of Sample S-2-3

TEM/SAED Analysis of Sample S-2-5

TEM/SAED Analysis of S-2-7

STUDY NUMBER 2

DATA SOURCE:	**PRELIMINARY ENVIRONMENTAL ASSESSMENT OF THE LIGNITE-FIRED CAFB**
DATA STATUS:	EPA–600/7-79-048, February 1979
AUTHORS:	A. S. Werner, C. W. Young, William Piispanen, and B. M. Myatt
CONTRACTOR:	GCA Corporation GCA/Technology Division Bedford, Massachusetts 01730
PROJECT OFFICER:	Samuel L. Rakes Industrial Environmental Research Laboratory Office of Energy, Minerals, and Industry U.S. Environmental Protection Agency Research Triangle Park, NC 27711

PRELIMINARY ENVIRONMENTAL ASSESSMENT OF THE LIGNITE-FIRED CAFB

The chemically active fluid bed (CAFB) is a process in which "oil or coal is fed continuously into a fluidized bed of limestone maintained at 850 ±70° C by preheated substoichiometric air. In this gasification unit fuel is successively vaporized, oxidized, cracked, and reduced. Sulfur in the fuel forms various gaseous species which in turn react with the bed stone to form calcium sulfide-coated lime. Some of the fuel-bound trace elements are also bound to the lime particles. The low-Btu, low-sulfur product gas generated in the gasifier is passed through cyclones to a conventional natural gas boiler where it undergoes combustion. The sulfided stone left in the gasifier is cycled to a regenerator unit where it is oxidized to produce lime which is returned to the gasifier and sulfur dioxide which is sent to a sulfur recovery unit." Figure 2-1 (from the document) is a unit operations flow diagram of the 2.93-MW pilot plant CAFB at the ESSO Research Centre in Abingdon, England, where this testing was performed.

This study, conducted from January 24 through January 27, 1978, focused on gaseous emissions from lignite combustion in the Abingdon CAFB. An earlier study[8] by the same contractor at this location focused on oil combustion. The goals of this study were stated as:

1. Evaluation of the potential environmental impact of a lignite-fired CAFB,
2. Identification of additional control needs,
3. Recommendations for Level 2 testing, and
4. Updating of cost information on the CAFB and on alternative technologies.

---

[8] Werner, A. S., C. W. Young, M. I. Bornstein, R. M. Bradway, M. T. Mills, and D. F. Durocher. Preliminary Environmental Assessment of the CAFB. GCA/Technology Division, Bedford, Massachusetts. Prepared for the U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. Publication No. EPA-600/7-76-017. October 1976. 324 pp. (NTIS No. PB 262-001/AS).

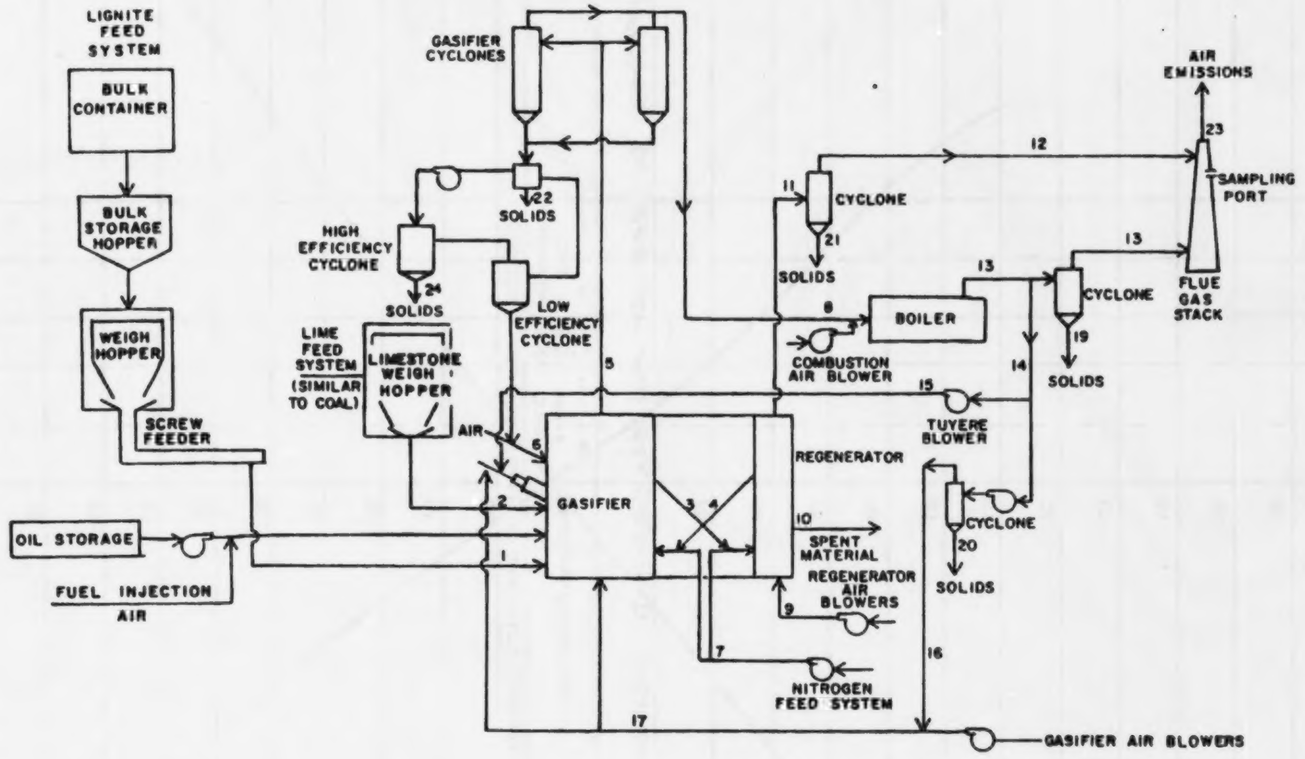
LIGNITE FEED SYSTEM
BULK CONTAINER
BULK STORAGE HOPPER
WEIGH HOPPER
SCREW FEEDER
OIL STORAGE
FUEL INJECTION AIR
GASIFIER CYCLONES
22
SOLIDS
HIGH EFFICIENCY CYCLONE
24
SOLIDS
LOW EFFICIENCY CYCLONE
LIME FEED SYSTEM (SIMILAR TO COAL)
LIMESTONE WEIGH HOPPER
AIR
6
2
1
5
GASIFIER
3
4
REGENERATOR
10
SPENT MATERIAL
REGENERATOR AIR BLOWERS
9
7
NITROGEN FEED SYSTEM
17
GASIFIER AIR BLOWERS
16
11
CYCLONE
21
SOLIDS
8
COMBUSTION AIR BLOWER
BOILER
13
12
15
TUYERE BLOWER
14
CYCLONE
20
SOLIDS
CYCLONE
19
SOLIDS
13
23
AIR EMISSIONS
SAMPLING PORT
FLUE GAS STACK

Figure 2-1. Unit operations flow diagram of the ESSO pilot plant.

The Abingdon CAFB is at present the only operating CAFB. A 10-MW retrofit demonstration plant is being constructed at La Palma Power Station in San Benito, Texas. Comparisons between oil-firing and coal-firing (lignite-firing) processes and between potential emissions at the two plants are thoroughly discussed in this document. In comparison with lignite-fired CAFB runs, oil-fired runs contained more sulfur, sodium, and vanadium and no detectable aluminum or silicon; these differences were attributed to differences in the fuel composition. Organic emissions varied widely as a function of gasifier operating conditions and were not easily correlated with fuel type.

Comparisons between the CAFB and conventional coal/lignite-fired boilers are also presented. The Source Analysis Model, SAM/1A, is used to compare the various technologies. Particulate emissions were about three times lower for lignite-fired CAFB than for conventional lignite-fired boilers using multicyclones; however, a conventional lignite-fired boiler with an ESP had lower particulate emissions by a factor of about 2,000. Inorganic analyses of stack gases supported the theory that the CAFB limestone bed material adsorbs trace metals. CAFB gaseous C_1-C_6 organic emissions were equivalent to those from conventional systems and greater than C_6 organic emissions from CAFBs were lower; CAFB SO_2 and NO_x emissions were also lower.

Appendix A of the final report presents a cost/benefits analysis of three pollution reduction technologies: CAFB, hydrodesulfurization (HDS), and flue gas desulfurization (FGD). CAFB appears to be more efficient at reducing NO_x and trace metals in emissions, but CAFB capital and operating costs are significantly higher.

This study used the Level 1 protocol. Additional sampling techniques included a modified RAC train (with particulate filter, Tenax-GC cartridge, and thermostatically controlled water jacket) and in-stack Andersen impactors. Additional measurement techniques included X-ray photoelectron spectroscopy (or ESCA) and Federal Register Method 8, performed for sulfur species because the GC-FPD field system prescribed by Level 1 methodology was inoperative at the time of these tests. Integrated bag sampling was used for C_1-C_6 hydrocarbons, fixed gases, and NO_x.

In addition to the gaseous emissions, samples were taken of lignite feed, limestone feed, spent stone, gasifier bed material, and process cyclone catches. These solid samples were collected by plant personnel and provided to the sampling crew. Table 2-1 (from the final report) lists the various samples collected and analyses performed. All mercury analyses were by the cold vapor atomic absorption (AA) method, sulfate analyses were by a turbidimetric procedure, and fluoride and chloride determinations were by specific ion electrode.

This study compared results from the various sampling methods. The SASS and RAC particulate loading values generally agreed within a factor of three, although RAC values were consistently lower. An exception was the arsenic measurement, in which the RAC values were lower by a factor of 20 to 40. The organic adsorption modules, using XAD-2 in the SASS and Tenax-GC in the RAC, produced results that were qualitatively similar, although process variations during sample collection prohibit quantitative comparisons. The SASS and the Andersen impactors showed good agreement with regard to size distribution.

Additional conclusions and recommendations from this study were:

1. Particulate emissions at this CAFB were 20 to 40 times higher than the new source performance standards (NSPS) for coal-fired boilers, and 10 to 30 percent of particulates were in the respirable range. Better controls must be developed.

2. Fourteen elements were found at levels above their MATE values; these were Ba, As, Ni, Cr, Ti, P, Si, Mg, B, Be, Cd, Sr, Cu, and Li. A reduction in particulate emissions would also reduce emitted levels of these elements.

3. NO_x emissions were well below the NSPS.

4. SO_2 emissions were roughly half the NSPS. Considering uncertainty in measurements and variations in the efficiency of the CAFB to remove sulfur, the process variables favoring sulfur removal should be carefully studied and optimized.

TABLE 2-1. LABORATORY ANALYSIS PLAN FOR CAFB-LIGNITE STUDY

Organic Analysis

- SASS samples
  - Particulate
  - Resin (XAD-2)
  - Condensate
  - Rinses
- RAC samples
  - Particulate (composite of probe rinses; runs 1 to 5)
  - Tenax (runs 2 and 4)
- Bulk samples
  - Spent solids

Inorganic Analysis

- SASS samples
  - Particulate
  - Resin (XAD-2)
  - Condensate
  - Impingers
  - Rinses
- RAC samples
  - Particulate (runs 1, 3, and 5)
- Bulk samples
  - Lignite
  - Limestone
  - Spent solids
  - Cyclone fines
  - Gasifier bed

Surface Analysis

- SASS samples
  - Particulate
- RAC samples
  - Particulate
- Impactor substrates

LEVEL 1

TABLE 2-2. SPARK SOURCE MASS SPECTROSCOPY
RUN #1, 10-μm CYCLONE
μg/m^3

U	2.50	Dy	<2.77	Rh	<0.30	Cr	19.21
Th	6.92	Tb	<0.01	Ru	<0.08	V	42.26
Bi	<2.15	Gd	<1.38	Mo	1.15	Ti	3,034.96
Pb	29.58	Eu	0.50	Nb	12.68	Sc	NR
Tl	<0.37	Sm	2.88	Zr	72.99	Ca	31,117.94
Hg	NR	Nd	6.53	Y	25.74	K	806.76
Au	<0.10	Pr	1.96	Sr	422.59	Cl	NR
Pt	NR	Ce	15.37	Rb	8.84	S	MC
Ir	<0.15	La	21.51	Br	38.42	P	103.73
Os	<0.16	Ba	318.86	Se	<25.74	Si	31,886.29
Re	<0.10	Cs	0.92	As	92.20	Al	MC
W	0.54	I	1.23	Ge	5.76	Mg	2,266.62
Ta	NR	Te	<1.50	Ga	14.98	Na	422.59
Hf	<2.38	Sb	0.85	Zn	315.02	F	NR
Lu	<0.96	Sn	2.77	Cu	46.10	B	161.35
Yb	<0.73	In	NR	Ni	21.90	Be	1.69
Tm	<0.29	Cd	0.73	Co	9.99	Li	NR
Er	<1.04	Ag	NR	Fe	MC		
Ho	<0.20	Pd	<1.61	Mn	922.01		

MC = Major component of the sample.
NR = Not reported.

TABLE 2-3. SPARK SOURCE MASS SPECTROSCOPY
RUN #1, 3-μm CYCLONE
$\mu g/m^3$

U	10.76	Dy	<2.54	Rh	<0.11	Cr	28.04
Th	21.90	Tb	<0.05	Ru	<0.34	V	107.57
Bi	<18.44	Gd	<0.25	Mo	3.07	Ti	3,841.72
Pb	53.78	Eu	<1.58	Nb	27.66	Sc	NR
Tl	<0.26	Sm	<6.15	Zr	207.45	Ca	*
Hg	NR	Nd	13.83	Y	38.42	K	5,378.41
Au	<0.42	Pr	4.61	Sr	1,152.52	Cl	NR
Pt	NR	Ce	32.65	Rb	19.21	S	9,988.47
Ir	<0.61	La	46.10	Br	61.47	P	806.76
Os	<0.69	Ba	806.76	Se	<14.98	Si	*
Re	<0.42	Cs	1.46	As	226.66	Al	21,513.64
W	<1.61	I	<0.96	Ge	<18.06	Mg	8,067.61
Ta	NR	Te	<1.84	Ga	65.31	Na	3,419.13
Hf	<4.99	Sb	2.57	Zn	261.24	F	NR
Lu	<2.00	Sn	5.76	Cu	35.73	B	1,190.93
Yb	<2.11	In	NR	Ni	92.20	Be	2.61
Tm	<0.15	Cd	1.08	Co	15.37	Li	NR
Er	<0.46	Ag	NR	Fe	18,440.26		
Ho	<0.85	Pd	<3.50	Mn	384.17		

NR = Not reported.
*Value exceeds 1 g.

TABLE 2-4. SPARK SOURCE MASS SPECTROSCOPY
RUN #1, 1-µm CYCLONE
µg/m^3)

U	3.34	Dy	<4.99	Rh	<0.13	Cr	38.42
Th	13.45	Tb	<0.06	Ru	<0.42	V	130.62
Bi	<11.53	Gd	<1.96	Mo	3.03	Ti	4,994.24
Pb	96.04	Eu	<1.31	Nb	34.19	Sc	NR
Tl	<0.42	Sm	<7.68	Zr	192.09	Ca	*
Hg	NR	Nd	8.45	Y	49.94	K	3,803.30
Au	<0.50	Pr	2.80	Sr	768.34	Cl	NR
Pt	NR	Ce	42.26	Rb	16.90	S	17,287.74
Ir	<0.77	La	115.25	Br	53.78	P	537.84
Os	<0.85	Ba	1,498.27	Se	<26.12	Si	30,349.60
Re	<0.54	Cs	0.92	As	280.45	Al	11,140.99
W	<2.00	I	<0.29	Ge	<11.53	Mg	3,611.22
Ta	NR	Te	<3.84	Ga	72.99	Na	960.43
Hf	<12.68	Sb	3.03	Zn	203.61	F	NR
Lu	<2.42	Sn	4.99	Cu	61.47	B	2,650.79
Yb	<1.96	In	NR	Ni	80.68	Be	9.22
Tm	<0.18	Cd	1.04	Co	18.82	Li	NR
Er	<3.80	Ag	NR	Fe	13,446.02		
Ho	<0.73	Pd	<1.46	Mn	268.92		

NR = Not reported.
*Value exceeds 1 g.

TABLE 2-9. SPARK SOURCE MASS SPECTROSCOPY RUN #1, SASS FILTER CATCH µg/m³

U	0.33	Dy	0.16	Rh	<0.05	Cr	5.76
Th	0.46	Tb	<3.84 (-03)	Ru	<0.01	V	3.19
Bi	0.54	Gd	<0.10	Mo	0.46	Ti	69.15
Pb	4.61	Eu	0.04	Nb	0.10	Sc	NR
Tl	<0.15	Sm	0.18	Zr	2.38	Ca	1,690.36
Hg	NR	Nd	0.50	Y	0.46	K	169.04
Au	<0.01	Pr	0.15	Sr	20.36	Cl	NR
Pt	NR	Ce	2.31	Rb	0.58	S	653.09
Ir	<0.01	La	1.27	Br	<0.96	P	13.06
Os	<0.01	Ba	13.45	Se	<0.77	Si	<192.09
Re	<0.01	Cs	0.12	As	2.50	Al	537.84
W	<0.12	I	<0.01	Ge	<0.25	Mg	338.07
Ta	NR	Te	<0.20	Ga	3.84	Na	MC
Hf	<0.13	Sb	0.19	Zn	<25.36	F	NR
Lu	<0.01	Sn	<0.96	Cu	<9.60	B	<23.05
Yb	<0.08	In	NR	Ni	<4.99	Be	0.04
Tm	<0.02	Cd	1.04	Co	0.46	Li	NR
Er	<0.08	Ag	NR	Fe	207.45		
Ho	0.02	Pd	<0.07	Mn	9.60		

MC = Major component of the sample.
NR = Not reported.

TABLE 2-6. SPARK SOURCE MASS SPECTROSCOPY RUN #1, XAD-2 RESIN

μg/m^3

U	<0.69	Dy	<0.32	Rh	<0.14	Cr	<3.46
Th	<1.00	Tb	<0.09	Ru	<0.50	V	<0.77
Bi	<0.31	Gd	<0.32	Mo	<0.46	Ti	<2.57
Pb	<10.76	Eu	<0.15	Nb	<0.06	Sc	NR
Tl	<0.38	Sm	<0.58	Zr	<0.23	Ca	<353.44
Hg	NR	Nd	<0.69	Y	<0.09	K	<184.40
Au	<0.54	Pr	<0.12	Sr	<8.07	Cl	NR
Pt	NR	Ce	<0.17	Rb	<0.23	S	<4,610.07
Ir	<0.81	La	<0.18	Br	<33.42	P	<61.47
Os	<0.88	Ba	<2.92	Se	<2.31	Si	<537.84
Re	<0.54	Cs	<0.03	As	0.22	Al	<76.83
W	<0.73	I	<0.50	Ge	<0.19	Mg	<238.19
Ta	NR	Te	<0.42	Ga	<0.08	Na	<960.43
Hf	<0.92	Sb	<0.28	Zn	<61.47	F	NR
Lu	<0.22	Sn	1.50	Cu	<96.04	B	4.23
Yb	<0.32	In	NR	Ni	<57.63	Be	<0.05
Tm	<0.19	Cd	<0.50	Co	<1.81	Li	NR
Er	<0.58	Ag	NR	Fe	65.31		
Ho	<0.18	Pd	<0.38	Mn	<5.76		

NR = Not reported.

TABLE 2-7. SPARK SOURCE MASS SPECTROSCOPY
RUN #1, COMPOSITE SAMPLE
μg/m^3

U	<0.50	Dy	<0.24	Rh	<0.10	Cr	12.29
Th	<0.77	Tb	<0.07	Ru	<0.38	V	0.30
Bi	<0.23	Gd	<0.24	Mo	<0.36	Ti	<1.34
Pb	<2.69	Eu	<0.11	Nb	<0.05	Sc	NR
Tl	<0.29	Sm	<0.42	Zr	<0.17	Ca	6,530.93
Hg	NR	Nd	<0.54	Y	<0.07	K	<26.12
Au	<0.38	Pr	<0.09	Sr	0.30	Cl	NR
Pt	NR	Ce	<0.12	Rb	<0.12	S	4,610.07
Ir	<0.61	La	<0.13	Br	<2.88	P	<153.67
Os	<0.65	Ba	0.50	Se	0.50	Si	14.60
Re	<0.42	Cs	<0.02	As	<0.46	Al	8.84
W	<0.54	I	<0.36	Ge	<0.14	Mg	9.99
Ta	NR	Te	<0.30	Ga	<0.06	Na	<130.62
Hf	<0.69	Sb	<0.21	Zn	17.29	F	NR
Lu	<0.16	Sn	49.94	Cu	23.05	B	4.32
Yb	<0.23	In	NR	Ni	13.45	Be	3.84 (-03)
Tm	<0.14	Cd	1.11	Co	<0.96	Li	NR
Er	<0.42	Ag	NR	Fe	145.99		
Ho	<0.14	Pd	<0.30	Mn	5.76		

NR = Not reported.

TABLE 2-8. SPARK SOURCE MASS SPECTROSCOPY
RUN #1, TOTAL SASS CATCH
µg/m^3

U	16.90	Dy	0.16 to 8.84	Rh	<0.85	Cr	103.73
Th	42.26	Tb	<0.28	Ru	<1.77	V	2,842.87
Bi	0.54 to 32.65	Gd	<4.23	Mo	7.68	Ti	11,909.34
Pb	184.40	Eu	0.54 to 3.15	Nb	72.99	Sc	NR
Tl	<1.96	Sm	3.07 to 14.98	Zr	461.01	Ca	*
Hg	NR	Nd	29.20	Y	115.25	K	9,988.47
Au	<1.92	Pr	9.60	Sr	2.381.87	Cl	NR
Pt	NR	Ce	92.20	Rb	46.10	S	†
Ir	<2.96	La	184.40	Br	153.67	P	1,459.85
Os	<3.23	Ba	2,650.79	Se	0.50 to 69.15	Si	*
Re	<2.04	Cs	3.46	As	614.68	Al	-
W	<5.76	I	1.23	Ge	5.76 to 30.35	Mg	14,598.54
Ta	NR	Te	<8.07	Ga	157.51	Na	†
Hf	<21.90	Sb	6.53	Zn	806.76	F	NR
Lu	<5.76	Sn	65.31	Cu	165.19	B	3,841.72
Yb	<5.38	In	NR	Ni	211.29	Be	13.45
Tm	<1.00	Cd	4.99	Co	46.10	Li	NR
Er	<6.53	Ag	NR	Fe	†		
Ho	0.02 to 2.11	Pd	<7.30	Mn	1,575.11		

NR = Not reported.
*Total and emission values were not calculated owing to the presence of an MC concentration.
†Value exceeds 1 g.

TABLE 2-9. SPARK SOURCE MASS SPECTROSCOPY
RUN #1, EMISSION FOUND
(mg/m^3)

U	0.017	Dy	0.0002 to 0.0087	Rh	<0.0008	Cr	0.100
Th	0.043	Tb	<0.0003	Ru	<0.0018	V	0.28
Bi	0.0005 to 0.033	Gd	<0.0042	Mo	0.0077	Ti	12
Pb	0.18	Eu	0.0005 to 0.0031	Nb	0.075	Sc	NR
Tl	<0.0020	Sm	0.0031 to 0.015	Zr	0.47	Ca	190
Hg	NR	Nd	0.029	Y	0.12	K	10
Au	<0.0019	Pr	0.0095	Sr	2.4	Cl	NR
Pt	NR	Ce	0.091	Rb	0.046	S	*
Ir	<0.0030	La	0.18	Br	0.15	P	1.5
Os	<0.0032	Ba	2.6	Se	0.0005 to 0.070	Si	210
Re	<0.0020	Cs	0.0034	As	0.60	Al	*
W	<0.0056	I	0.0012	Ge	0.0058 to 0.030	Mg	14
Ta	NR	Te	<0.0081	Ga	0.16	Na	*
Hf	<0.022	Sb	0.0067	Zn	0.80	F	NR
Lu	<0.0058	Sn	0.066	Cu	0.17	B	4.0
Yb	<0.0055	In	NR	Ni	0.21	Be	0.013
Tm	<0.0010	Cd	0.0050	Co	0.045	Li	NR
Er	<0.0064	Ag	NR	Fe	*		
Ho	<0.0001 to 0.0021	Pd	<0.0074	Mn	1.6		

NR = Not reported.
*Total and emission values were not calculated owing to the presence of an MC concentration.

TABLE 2-10. SPARK SOURCE MASS SPECTROSCOPY
RUN #2, 10-μm CYCLONE
μg/m^3

U	3.85	Dy	<2.92	Rh	<0.44	Cr	31.83
Th	10.74	Tb	<0.04	Ru	<0.24	V	132.61
Bi	<4.64	Gd	<2.12	Mo	2.52	Ti	5,039.12
Pb	27.85	Eu	<1.46	Nb	19.89	Sc	NR
Tl	<0.24	Sm	<7.29	Zr	132.61	Ca	31,826.02
Hg	NR	Nd	<26.52	Y	27.85	K	2,917.38
Au	<0.29	Pr	3.18	Sr	2,652.17	Cl	NR
Pt	NR	Ce	46.41	Rb	27.85	S	91,499.80
Ir	<0.46	La	46.41	Br	86.20	P	570.22
Os	<0.49	Ba	861.95	Se	<55.70	Si	MC
Re	<0.30	Cs	1.03	As	477.39	Al	MC
W	<1.15	I	2.78	Ge	<17.24	Mg	6,099.99
Ta	NR	Te	<2.25	Ga	45.09	Na	1,856.52
Hf	<14.59	Sb	4.91	Zn	1,458.69	F	NR
Lu	<4.11	Sn	4.64	Cu	70.28	B	1,458.69
Yb	<1.46	In	NR	Ni	33.15	Be	0.93
Tm	<0.60	Cd	0.50	Co	10.87	Li	33.15
Er	<2.12	Ag	NR	Fe	MC		
Ho	<0.42	Pd	<2.52	Mn	1,591.30		

NR = Not reported.

MC = Major component of the sample.

TABLE 2-11. SPARK SOURCE MASS SPECTROSCOPY
RUN #2, 3-μm CYCLONE
$\mu g/m^3$

U	6.63	Dy	<5.17	Rh	<0.07	Cr	17.24
Th	18.57	Tb	<0.03	Ru	<0.21	V	115.37
Bi	<15.91	Gd	<3.05	Mo	3.05	Ti	4,376.08
Pb	132.61	Eu	<2.78	Nb	23.87	Sc	NR
Tl	<0.21	Sm	<10.87	Zr	238.70	Ca	108,738.89
Hg	NR	Nd	11.80	Y	25.20	K	3,315.21
Au	<0.25	Pr	3.85	Sr	1,312.82	Cl	NR
Pt	NR	Ce	19.89	Rb	23.87	S	26,521.68
Ir	<0.38	La	114.04	Br	75.59	P	278.48
Os	<0.42	Ba	2,784.78	Se	<68.96	Si	53,043.36
Re	<0.27	Cs	1.23	As	145.87	Al	15,913.01
W	<2.92	I	<0.42	Ge	10.74	Mg	2,784.78
Ta	NR	Te	<2.39	Ga	79.57	Na	1,312.82
Hf	<9.42	Sb	4.24	Zn	225.43	F	NR
Lu	<3.58	Sn	5.70	Cu	87.52	B	729.35
Yb	<2.56	In	NR	Ni	58.35	Be	1.13
Tm	<0.09	Cd	0.93	Co	18.57	Li	15.91
Er	<1.86	Ag	NR	Fe	21,217.35		
Ho	<1.05	Pd	<2.12	Mn	238.70		

NR = Not reported.

TABLE 2-12. SPARK SOURCE MASS SPECTROSCOPY
RUN #2, 1-µm CYCLONE
$\mu g/m^3$

U	2.39	Dy	<2.65	Rh	<0.04	Cr	251.96
Th	4.64	Tb	<0.01	Ru	<0.11	V	172.39
Bi	<0.34	Gd	<0.90	Mo	2.12	Ti	4,110.86
Pb	132.61	Eu	<0.49	Nb	34.48	Sc	NR
Tl	<2.92	Sm	0.96	Zr	172.39	Ca	MC
Hg	NR	Nd	4.24	Y	34.48	K	1,591.30
Au	<0.12	Pr	3.71	Sr	954.78	Cl	NR
Pt		Ce	27.85	Rb	11.93	S	7,293.46
Ir	<0.20	La	41.11	Br	25.20	P	742.61
Os	<0.21	Ba	1,458.69	Se	<34.48	Si	42,434.69
Re	<0.13	Cs	1.23	As	384.56	Al	MC
W	<1.05	I	<0.30	Ge	30.50	Mg	6,099.99
Ta	NR	Te	<1.19	Ga	128.63	Na	1,856.52
Hf	<3.18	Sb	8.09	Zn	159.13	F	NR
Lu	<0.61	Sn	7.96	Cu	61.00	B	663.04
Yb	<0.70	In	NR	Ni	42.43	Be	1.59
Tm	<0.54	Cd	0.58	Co	13.26	Li	8.22
Er	<0.95	Ag	NR	Fe	18,565.18		
Ho	<0.27	Pd	<1.59	Mn	225.43		

NR = Not reported.
MC = Major component of the sample.

TABLE 2-13. SPARK SOURCE MASS SPECTROSCOPY
RUN #2, SASS FILTER CATCH
$\mu g/m^3$

U	0.30	Dy	<0.89	Rh	<0.03	Cr	6.90
Th	0.44	Tb	<0.04	Ru	<0.20	V	1.86
Bi	0.52	Gd	<0.16	Mo	0.84	Ti	70.28
Pb	6.10	Eu	0.03	Nb	0.19	Sc	NR
Tl	<0.20	Sm	0.17	Zr	1.46	Ca	3,182.60
Hg	NR	Nd	0.98	Y	0.60	K	<122.00
Au	<0.01	Pr	0.15	Sr	57.02	Cl	NR
Pt	NR	Ce	2.12	Rb	<1.46	S	1,127.17
Ir	<0.03	La	1.18	Br	<1.21	P	9.81
Os	<0.03	Ba	<91.50	Se	3.85	Si	<225.43
Re	<0.13	Cs	<0.27	As	3.18	Al	1,458.69
W	<0.16	I	<0.03	Ge	0.12	Mg	185.65
Ta	NR	Te	0.13	Ga	8.49	Na	<3,447.82
Hf	<0.17	Sb	0.69	Zn	<35.80	F	NR
Lu	<0.01	Sn	<4.91	Cu	<23.87	B	<23.87
Yb	<0.09	In	NR	Ni	<4.38	Be	<0.05
Tm	<0.03	Cd	<2.25	Co	<0.50	Li	<0.49
Er	<0.12	Ag	<2.25	Fe	145.87		
Ho	<0.08	Pd	<0.09	Mn	7.29		

NR = Not reported.

TABLE 2-14. SPARK SOURCE MASS SPECTROSCOPY
RUN #2, XAD-2 RESIN
ug/m^3

U	<13.26	Dy	<6.23	Rh	<2.78	Cr	<14.59
Th	<19.89	Tb	<1.72	Ru	<10.08	V	<1.86
Bi	<6.10	Gd	<6.23	Mo	<9.28	Ti	<25.20
Pb	<35.80	Eu	<2.78	Nb	<1.17	Sc	NR
Tl	<7.56	Sm	<10.87	Zr	<4.38	Ca	<2,254.34
Hg	NR	Nd	<13.26	Y	<1.86	K	<1,326.08
Au	<10.08	Pr	<2.39	Sr	<37.13	Cl	NR
Pt	NR	Ce	<3.32	Rb	<6.37	S	74,260.71
Ir	<15.91	La	<3.58	Br	<225.43	P	<596.74
Os	<17.24	Ba	6.76	Se	<5.30	Si	<1,312.82
Re	<10.74	Cs	<0.57	As	<2.12	Al	<517.17
W	<14.59	I	<9.42	Ge	<3.71	Mg	<822.17
Ta	NR	Te	<7.82	Ga	<1.59	Na	<10,078.24
Hf	<18.57	Sb	<5.44	Zn	<265.22	F	NR
Lu	<4.24	Sn	<7.69	Cu	<344.78	B	<53.04
Yb	<6.10	In	NR	Ni	<570.22	Be	<0.16
Tm	<3.71	Cd	<9.68	Co	<4.24	Li	<2.39
Er	<11.01	Ag	NR	Fe	<861.95		
Ho	<3.58	Pd	<7.82	Mn	<29.17		

NR = Not reported.

TABLE 2-15. SPARK SOURCE MASS SPECTROSCOPY RUN #2, COMPOSITE SAMPLE $\mu g/m^3$

U	<2.92	Dy	<1.33	Rh	<0.58	Cr	18.57
Th	<4.11	Tb	<0.36	Ru	<2.12	V	<0.76
Bi	<1.29	Gd	<1.31	Mo	3.98	Ti	<13.00
Pb	<2.65	Eu	<0.60	Nb	0.34	Sc	NR
Tl	<1.59	Sm	<2.25	Zr	<0.93	Ca	<291.74
Hg	NR	Nd	<2.92	Y	<0.38	K	<100.78
Au	<2.12	Pr	<0.50	Sr	0.66	Cl	NR
Pt	NR	Ce	<0.69	Rb	0.12	S	21,217.35
Ir	<3.32	La	<0.74	Br	<8.22	P	<848.69
Os	<3.58	Ba	1.46	Se	10.21	Si	<198.91
Re	<2.25	Cs	<0.12	As	0.44	Al	<76.91
W	<3.05	I	<1.99	Ge	<0.80	Mg	<92.83
Ta	NR	Te	<1.72	Ga	<0.32	Na	<716.09
Hf	<3.85	Sb	<1.15	Zn	<62.33	F	NR
Lu	<0.89	Sn	<384.56	Cu	37.13	B	128.63
Yb	<1.29	In	NR	Ni	<63.65	Be	<0.01
Tm	<0.80	Cd	<15.91	Co	0.93	Li	<1.86
Er	<2.39	Ag	NR	Fe	<251.96		
Ho	<0.76	Pd	<1.59	Mn	<12.60		

NR = Not reported.

TABLE 2-16. SPARK SOURCE MASS SPECTROSCOPY
RUN #2, TOTAL SASS CATCH
μg/m³

U	13.26	Dy	<19.89	Rh	<3.85	Cr	331.52
Th	34.48	Tb	<2.12	Ru	<13.00	V	424.35
Bi	0.52 to 27.85	Gd	<13.26	Mo	12.47	Ti	13,260.84
Pb	305.00	Eu	0.03 to 8.09	Nb	78.24	Sc	NR
Tl	<12.73	Sm	1.13 to 31.83	Zr	543.69	Ca	*
Hg	NR	Nd	17.24 to 43.76	Y	87.52	K	7,691.29
Au	<13.00	Pr	10.87	Sr	5,039.12	Cl	NR
Pt	NR	Ce	96.80	Rb	63.65	S	†
Ir	<19.89	La	198.91	Br	185.65	P	1,591.30
Os	<21.22	Ba	5,039.12	Se	14.59 to 159.13	Si	*
Re	<13.26	Cs	3.45	As	1,007.82	Al	*
W	<22.54	I	2.78 to 12.07	Ge	41.11	Mg	14,586.92
Ta	NR	Te	0.13 to 15.91	Ga	265.22	Na	5,039.12 to 14,586.92
Hf	<49.07	Sb	18.57	Zn	1,856.52	F	NR
Lu	<13.26	Sn	18.57 to 397.83	Cu	251.96	B	3,049.99
Yb	<12.47	In	NR	Ni	132.61 to 636.52	Be	3.86
Tm	<5.83	Cd	1.99 to 27.85	Co	43.76	Li	61.00
Er	<18.57	Ag	NR	Fe	*		
Ho	<6.23	Pd	<15.91	Mn	1,989.13		

NR = Not reported.

*Total and emission values were not calculated owing to the presence of an MC concentration.

†Value exceeds 1 g.

TABLE 2-17. SPARK SOURCE MASS SPECTROSCOPY RUN #2, EMISSION FOUND
(mg/m^3)

U	0.013	Dy	<0.019	Rh	<0.0039	Cr	0.33
Th	0.035	Tb	<0.0022	Ru	<0.013	V	0.43
Bi	0.0005 to 0.028	Gd	<0.014	Mo	0.012	Ti	14
Pb	0.31	Eu	<0.0001 to 0.008	Nb	0.079	Sc	NR
Tl	<0.013	Sm	0.0011 to 0.031	Zr	0.54	Ca	*
Hg	NR	Nd	0.017 to 0.044	Y	0.088	K	7.7
Au	<0.013	Pr	0.011	Sr	5.0	Cl	NR
Pt	NR	Ce	0.097	Rb	0.063	S	220
Ir	<0.020	La	0.20	Br	0.19	P	1.6
Os	<0.022	Ba	5.1	Se	0.014 to 0.16	Si	*
Re	<0.014	Cs	0.0035	As	1.0	Al	*
W	<0.023	I	0.0027 to 0.012	Ge	0.041	Mg	15
Ta	NR	Te	0.0001 to 0.015	Ga	0.26	Na	5.0 to 14
Hf	<0.049	Sb	0.018	Zn	1.9	F	NR
Lu	<0.013	Sn	0.018 to 0.40	Cu	0.26	B	3.1
Yb	<0.012	In	NR	Ni	0.13 to 0.64	Be	0.0038
Tm	<0.0058	Cd	0.0020 to 0.028	Co	0.044	Li	0.060
Er	<0.018	Ag	NR	Fe	*		
Ho	<0.0062	Pd	<0.016	Mn	2.0		

NR = Not reported.
*Total and emission values were not calculated owing to the presence of an MC concentration.

TABLE 2-18. SPARK SOURCE MASS SPECTROSCOPY
ESSO, ENGLAND, CAFB PILOT PLANT SASS-1
($\mu g/m^3$)

U	18	Dy	0.2 - 9.4	Rh	0.9	Cr	110
Th	46	Tb	<0.3	Ru	<1.9	V	310
Bi	0.6 - 35	Gd	<4.6	Mo	8.4	Ti	13,000
Pb	200	Eu	0.6 - 3.4	Nb	81	Sc	
Tl	<2.1	Sm	3.3 - 16.0	Zr	510	Ca	210,000
Hg		Nd	31	Y	120	K	11,000
Au	<2.1	Pr	10	Sr	2,600	Cl	
Pt		Ce	98	Rb	50	S	-
Ir	<3.2	La	200	Br	160	P	1,600
Os	<3.5	Ba	2,800	Se	0.6 - 75	Si	230,000
Re	<2.2	Cs	3.7	As	650	Al	-
W	<6.1	I	1.3	Ge	6.2 - 33	Mg	16,000
Ta		Te	8.8	Ga	170	Na	-
Hf	<24	Sb	7.2	Zn	860	F	
Lu	<6.2	Sn	71	Cu	180	B	4,300
Yb	<5.9	In		Ni	230	Be	14
Tm	<1.1	Cd	5.4	Co	48	Li	
Er	<6.9	Ag		Fe	-		
Ho	<0.1 - 2.3	Pd	7.9	Mn	1,700		

TABLE 2-19. SPARK SOURCE MASS SPECTROSCOPY
ESSO, ENGLAND, CAFB PILOT PLANT SASS-2
($\mu g/m^3$)

U	13	Dy	<19	Rh	<3.9	Cr	330
Th	35	Tb	<2.2	Ru	<13	V	430
Bi	0.5 to 28	Gd	<14	Mo	12	Ti	14,000
Pb	310	Eu	<0.1-8.1	Nb	78	Sc	
Tl	<13	Sm	1.1-31	Zr	540	Ca	-
Hg		Nd	17-44	Y	87	K	7,700
Au	<13	Pr	11	Sr	5,000	Cl	
Pt		Ce	97	Rb	63	S	220,000
Ir	<20	La	200	Br	190	P	1,600
Os	<22	Ba	5,100	Se	14-160	Si	-
Re	<14	Cs	3.5	As	1,000	Al	-
W	<23	I	2.7-12	Ge	41	Mg	15,000
Ta		Te	0.1-15	Ga	260	Na	5,000-14,000
Hf	<49	Sb	18	Zn	1,900	F	
Lu	<13	Sn	18-400	Cu	260	B	3,100
Yb	<12	In		Ni	130-630	Be	3.8
Tm	<5.8	Cd	2.0-27	Co	44	Li	
Er	<18	Ag		Fe	-		
Ho	<6.2	Pd	<16	Mn	2,000		

TABLE 2-20. SPARK SOURCE MASS SPECTROSCOPY CONVENTIONAL LIGNITE BOILER WITH MULTICLONE - SITE A

($\mu g/m^3$)

U	56	Dy	<3.2	Rh	6.6	Cr	470
Th	74	Tb	<0.7	Ru	<3.6	V	470
Bi	2.6	Gd	<3.2	Mo	38	Ti	28,000
Pb	320	Eu	<1.8	Nb	67	Sc	
Tl	<8.3	Sm	<5.4	Zr	1,300	Ca	-
Hg		Nd	13	Y	190	K	39,000
Au	<4.1	Pr	29	Sr	41,000	Cl	
Pt		Ce	240	Rb	290	S	160,000
Ir	<6.3	La	320	Br	210	P	16,000
Os	<7.0	Ba	200,000	Se	83	Si	-
Re	<4.5	Cs	18	As	1,600	Al	-
W	6.2 - 33	I	3.3	Ge	7.2	Mg	-
Ta		Te	<3.3	Ga	240	Na	-
Hf	<13	Sb	40	Zn	880	F	
Lu	<3	Sn	23	Cu	470	B	140,000
Yb	<3.2	In		Ni	1,400	Be	10
Tm	<2.5	Cd	33	Co	100	Li	570
Er	<4.8	Ag		Fe	-		
Ho	<1.1	Pd	<6.7	Mn	27,000		

TABLE 2-21. SPARK SOURCE MASS SPECTROSCOPY CONVENTIONAL LIGNITE BOILER WITH ESP SITE B ($\mu g/m^3$)

U	<1.2	Dy	<0.5	Rh	<0.2	Cr	<4.2
Th	<1.7	Tb	<0.1	Ru	<0.9	V	<1.1
Bi	<0.5	Gd	<0.5	Mo	0.8	Ti	<3.5
Pb	1.1-8.5	Eu	<0.2	Nb	<0.1	Sc	
Tl	<0.7	Sm	<0.9	Zr	0.3	Ca	40-390
Hg		Nd	<1.2	Y	<0.1-0.1	K	560
Au	<0.9	Pr	<0.2	Sr	<10	Cl	
Pt		Ce	<0.3	Rb	<0.1-0.4	S	1,400-7,700
Ir	<1.4	La	<0.3	Br	<43	P	<46
Os	<1.5	Ba	<28	Se	9.7	Si	180
Re	<0.9	Cs	<0.1	As	<4.2	Al	36-88
W	<1.3	I	<0.8	Ge	<0.1-0.3	Mg	160
Ta		Te	<0.7	Ga	<0.1-0.1	Na	680
Hf	<1.6	Sb	<0.5	Zn	13-31	F	
Lu	<0.4	Sn	1.3-16	Cu	<36	B	64
Yb	<0.5	In		Ni	<69	Be	0.2
Tm	<0.3	Cd	0.9-2.1	Co	<0.8	Li	<0.3
Er	<1	Ag		Fe	<170		
Ho	<0.3	Pd	<0.7	Mn	<7.8		

TABLE 2-22. SPARK SOURCE MASS SPECTROSCOPY PARTICULATE FILTER FROM SASS-1 (μg)

U	0.93	Dy	0.45	Rh	<0.066	Cr	17.
Th	1.4	Tb	<0.002	Ru	<0.010	V	9.3
Bi	1.5	Gd	<0.15	Mo	1.6	Ti	200
Pb	15	Eu	0.11	Nb	0.30	Sc	
Tl	<0.22	Sm	0.53	Zr	7.4	Ca	4,900
Hg		Nd	1.5	Y	1.3	K	510
Au	<0.010	Pr	0.44	Sr	59	Cl	
Pt		Ce	6.6	Rb	2.0	S	2,100
Ir	<0.016	La	3.6	Br	1.3	P	41
Os		Ba	70	Se	<1.1	Si	270
Re	<0.018	Cs	0.41	As	7.8	Al	1,600
W	<0.17	I	<0.010	Ge	<0.36	Mg	1000
Ta		Te	<0.29	Ga	11	Na	MC
Hf	<0.19	Sb	0.71	Zn	36	F	
Lu	<0.017	Sn	1.4	Cu	14	B	33
Yb	<0.11	In	14*	Ni	7.0	Be	0.16
Tm	<0.032	Cd	3.5	Co	1.5	Li	0.68
Er	<0.12	Ag		Fe	680		
Ho	0.061	Pd	<0.098	Mn	31		

*Internal standard.
NOTE: 0.0739 g (10.96 percent).

TABLE 2-23. SPARK SOURCE MASS SPECTROSCOPY PARTICULATE FILTER BLANK FROM SASS-1 AND SASS-2 (μg)

U	<0.025	Dy	<0.011	Rh	<0.005	Cr	0.70
Th	<0.036	Tb	<0.003	Ru	<0.018	V	0.21
Bi	<0.011	Gd	<0.011	Mo	0.24	Ti	0.68
Pb	2.1	Eu	<0.005	Nb	0.012	Sc	
Tl	<0.014	Sm	<0.020	Zr	0.54	Ca	73
Hg		Nd	<0.025	Y	0.009	K	36
Au	<0.018	Pr	<0.004	Sr	1.4	Cl	
Pt		Ce	0.049	Rb	0.35	S	230
Ir	<0.028	La	<0.006	Br	1.2	P	4.4
Os	<0.031	Ba	32	Se	0.25	Si	170
Re	<0.020	Cs	0.069	As	0.67	Al	16
W	<0.026	I	0.096	Ge	<0.056	Mg	35
Ta		Te	<0.014	Ga	<0.100	Na	1,700
Hf	<0.033	Sb	0.16	Zn	37.	F	
Lu	<0.008	Sn	2.4	Cu	19	B	32
Yb	<0.011	In	14*	Ni	11	Be	0.050
Tm	<0.007	Cd	0.54	Co	0.24	Li	0.13
Er	<0.020	Ag		Fe	92		
Ho	<0.007	Pd	<0.014	Mn	3.3		

***Internal standard.**
NOTE: 11.56 percent.

TABLE 2-24. SPARK SOURCE MASS SPECTROSCOPY PARTICULATE FILTER FROM SASS-2 (μg)

U	0.27	Dy	<0.40	Rh	<0.009	Cr	6.9
Th	0.40	Tb	<0.017	Ru	<0.093	V	1.8
Bi	0.47	Gd	<0.074	Mo	0.99	Ti	64
Pb	7.7	Eu	0.022	Nb	0.18	Sc	
Tl	<0.091	Sm	0.15	Zr	1.9	Ca	2,900
Hg		Nd	0.89	Y	0.55	K	55
Au	<0.006	Pr	0.14	Sr	53	Cl	
Pt		Ce	2.0	Rb	0.66	S	1,300
Ir	<0.009	La	1.1	Br	0.54	P	13
Os	<0.010	Ba	41	Se	3.7	Si	100
Re	<0.061	Cs	0.12	As	3.6	Al	1,300
W	<0.072	I	0.011	Ge	0.11	Mg	200
Ta		Te	0.12	Ga	7.7	Na	1,500
Hf	<0.079	Sb	0.79	Zn	16	F	
Lu	<0.007	Sn	2.2	Cu	11	B	11
Yb	<0.041	In	14*	Ni	2.0	Be	0.024
Tm	<0.013	Cd	1.0	Co	0.23	Li	0.22
Er	<0.055	Ag		Fe	220		
Ho	<0.036	Pd	<0.039	Mn	9.9		

*Internal standard.
NOTE: 0.0438 g.

TABLE 2-25. SPARK SOURCE MASS SPECTROSCOPY
CAFB LIGNITE
(ppm)

U	0.23	Dy	0.20	Rh	<0.010	Cr	2.7
Th	0.32	Tb	0.024	Ru	<0.030	V	14
Bi	0.20	Gd	0.061	Mo	0.43	Ti	230
Pb	9.6	Eu	<0.015	Nb	0.64	Sc	
Tl	<0.029	Sm	0.18	Zr	5.9	Ca	0.17 (%)
Hg		Nd	0.60	Y	0.65	K	92
Au	<0.036	Pr	0.14	Sr	37	Cl	
Pt		Ce	1.1	Rb	0.59	S	0.23 (%)
Ir	<0.055	La	1.5	Br	0.23	P	42
Os	<0.060	Ba	38	Se	2.8	Si	1.3 (%)
Re	<0.038	Cs	0.046	As	1.5	Al	0.23 (%)
W	0.100	I	0.040	Ge	0.20	Mg	130
Ta		Te	0.075	Ga	2.6	Na	180
Hf	<0.12	Sb	0.30	Zn	13	F	
Lu	<0.031	Sn	2.1	Cu	15	B	21
Yb	<0.090	In	21*	Ni	23	Be	0.030
Tm	<0.013	Cd	0.17	Co	0.50	Li	0.82
Er	<0.039	Ag		Fe	0.19 (%)		
Ho	<0.006	Pd	<0.037	Mn	22		

***Internal standard.**
NOTE: 0.6757 g.

TABLE 2-26. SPARK SOURCE MASS SPECTROSCOPY
CAFB STACK KNOCKOUT
(ppm)

U	9.3	Dy	<7.5	Rh	<0.095	Cr	62
Th	37	Tb	<0.042	Ru	<0.29	V	320.
Bi	<0.67	Gd	<1.8	Mo	4.2	Ti	
Pb	120	Eu	<1.8	Nb	47	Sc	
Tl	<1.9	Sm	<7.5	Zr	330	Ca	
Hg		Nd	34	Y	48	K	
Au	<0.35	Pr	11	Sr		Cl	
Pt		Ce	160	Rb	66	S	
Ir	<0.54	La	110	Br	100	P	760
Os	<0.59	Ba		Se	<36	Si	MC
Re	<0.37	Cs	6.8	As	120	Al	MC
W	<1.4	I	<1.2	Ge	<7.4	Mg	
Ta		Te	<2.7	Ga	79	Na	
Hf	<13	Sb	4.4	Zn	140	F	
Lu	<1.7	Sn	14	Cu	120	B	
Yb	<2.7	In	160*	Ni	220	Be	1.6
Tm	<1.1	Cd	2.6	Co	18	Li	81
Er	<3.1	Ag		Fe			
Ho	<1.0	Pd	<2.0	Mn	370		

*Internal standard.
NOTE: 0.0880 g.

TABLE 2-27. SPARK SOURCE MASS SPECTROSCOPY
CAFB STACK CYCLONE
(ppm)

U	6.6	Dy	5.3	Rh	<0.19	Cr	31
Th	19	Tb	<0.021	Ru	<0.15	V	160
Bi	<2.0	Gd	<2.5	Mo	2.6	Ti	1.1 (%)
Pb	34	Eu	0.95	Nb	47	Sc	
Tl	<0.14	Sm	<8.9	Zr	230	Ca	6.7 (%)
Hg		Nd	17	Y	68	K	0.82 (%)
Au	<0.17	Pr	7.2	Sr	0.12 (%)	Cl	
Pt		Ce	56	Rb	42	S	0.43 (%)
Ir	<0.27	La	110	Br	73	P	690
Os	<0.29	Ba	680	Se	<18	Si	MC
Re	<0.18	Cs	1.2	As	190	Al	MC
W	<1.0	I	0.83	Ge	<5.6	Mg	0.64 (%)
Ta		Te	<0.95	Ga	39	Na	0.27 (%)
Hf	<9.4	Sb	3.1	Zn	<59	F	
Lu	<1.8	Sn	3.5	Cu	61	B	590
Yb	<1.4	In	130*	Ni	56	Be	1.1
Tm	<0.75	Cd	1.0	Co	13	Li	68
Er	<2.7	Ag		Fe	2.8 (%)		
Ho	0.51	Pd	<1.0	Mn	620		

*Internal standard.
NOTE: 0.1064 g.

TABLE 2-28. SPARK SOURCE MASS SPECTROSCOPY
CAFB REGENERATOR CYCLONE
(ppm)

U	8.9	Dy	<3.8	Rh	<0.37	Cr	48
Th	24	Tb	<0.014	Ru	<0.098	V	180
Bi	<0.45	Gd	<1.7	Mo	2.8	Ti	0.41 (%)
Pb	53	Eu	1.2	Nb	32	Sc	
Tl	<1.3	Sm	<6.0	Zr	510	Ca	7.7 (%)
Hg		Nd	16	Y	64	K	0.100 (%)
Au	<0.12	Pr	6.9	Sr	0.100 (%)	Cl	
Pt		Ce	53	Rb	16	S	2.5 (%)
Ir	<0.18	La	38	Br	70	P	250
Os	<0.20	Ba	0.14 (%)	Se	<32	Si	7.9 (%)
Re	<0.12	Cs	2.3	As	710	Al	MC
W	<0.47	I	2.2	Ge	<6.8	Mg	0.56 (%)
Ta		Te	<0.90	Ga	52	Na	0.100 (%)
Hf	<8.7	Sb	3.0	Zn	67	F	
Lu	<1.7	Sn	3.7	Cu	57	B	400
Yb	<0.92	In	160*	Ni	54	Be	1.1
Tm	<0.36	Cd	1.3	Co	12	Li	8.4
Er	<1.8	Ag		Fe	1.9 (%)		
Ho	0.98	Pd	<1.5	Mn	230		

*Internal standard.
NOTE: 0.0888 g.

TABLE 2-29. SPARK SOURCE MASS SPECTROSCOPY
CAFB GASIFIER BED
(ppm)

U	<0.74	Dy	<0.40	Rh	<0.18	Cr	11
Th	<1.0	Tb	<0.078	Ru	<0.54	V	100
Bi	<0.44	Gd	<0.40	Mo	<0.33	Ti	0.18 (%)
Pb	<2.8	Eu	<0.28	Nb	12	Sc	
Tl	<0.54	Sm	<0.84	Zr	110	Ca	MC
Hg		Nd	<0.58	Y	17	K	0.56 (%)
Au	<0.65	Pr	<0.86	Sr	290	Cl	
Pt		Ce	9.7	Rb	15	S	3.2 (%)
Ir	<1.0	La	14	Br	72	P	260
Os	<1.1	Ba	150	Se	<48	Si	MC
Re	<0.69	Cs	0.60	As	720	Al	0.41 (%)
W	<0.46	I	<0.13	Ge	<15	Mg	1.4 (%)
Ta		Te	<0.49	Ga	47	Na	390
Hf	<2.3	Sb	23	Zn	67	F	
Lu	<0.56	Sn	19	Cu	40	B	960
Yb	<0.41	In	150*	Ni	36	Be	0.77
Tm	<0.24	Cd	<0.12	Co	9.1	Li	25
Er	<0.70	Ag		Fe	2.5 (%)		
Ho	<0.12	Pd		Mn	180		

*Internal standard.
NOTE: 0.0949 g.

TABLE 2-30. SPARK SOURCE MASS SPECTROSCOPY
CAFB REGENERATOR BED
(ppm)

U	1.1	Dy	<0.44	Rh	<0.18	Cr	4.2
Th	2.3	Tb	<0.015	Ru	<0.100	V	38
Bi	<0.083	Gd	<0.42	Mo	1.3	Ti	0.23 (%)
Pb	2.4	Eu	<0.052	Nb	8.2	Sc	
Tl	<0.100	Sm	<0.16	Zr	35	Ca	MC
Hg		Nd	2.0	Y	4.4	K	0.31 (%)
Au	<0.12	Pr	0.47	Sr	220	Cl	
Pt		Ce	6.8	Rb	29	S	0.30 (%)
Ir	<0.19	La	7.3	Br	36	P	85
Os	<0.20	Ba	130.	Se	<6.2	Si	3.2 (%)
Re	<0.13	Cs	0.45	As	240	Al	3.0 (%)
W	<0.24	I	0.20	Ge	5.3	Mg	0.48 (%)
Ta		Te	<0.091	Ga	14	Na	0.11 (%)
Hf	<1.5	Sb	6.1	Zn	24	F	
Lu	<0.100	Sn	9.8	Cu	21	B	140
Yb	<0.077	In	170*	Ni	14	Be	0.20
Tm	<0.25	Cd	0.041	Co	3.2	Li	16
Er	<0.13	Ag		Fe	0.36 (%)		
Ho	<0.12	Pd	<1.0	Mn	76		

*Internal standard.
NOTE: 0.0865 g.

TABLE 2-31. SPARK SOURCE MASS SPECTROSCOPY
CAFB OIL FEED
(ppm)

U	<0.049	Dy	<0.023	Rh	<0.23	Cr	0.98
Th	<0.071	Tb	<0.006	Ru	<0.037	V	49
Bi	0.12	Gd	<0.023	Mo	0.79	Ti	0.32
Pb	11	Eu	<0.010	Nb	0.024	Sc	
Tl	<0.028	Sm	<0.040	Zr	0.045	Ca	83
Hg		Nd	<0.050	Y	<0.007	K	99
Au	<0.037	Pr	<0.009	Sr	0.38	Cl	
Pt		Ce	<0.012	Rb	0.093	S	0.42 (%)
Ir	<0.057	La	<0.013	Br	0.28	P	15
Os	<0.062	Ba	0.41	Se	<0.019	Si	110
Re	<0.039	Cs	0.006	As	1.3	Al	31
W	<0.052	I	0.067	Ge	<0.014	Mg	31
Ta		Te	<0.029	Ga	<0.006	Na	150
Hf	<0.065	Sb	0.15	Zn	48	F	
Lu	<0.015	Sn	0.45	Cu	28	B	0.11
Yb	<0.022	In	17*	Ni	97	Be	0.001
Tm	<0.014	Cd	0.82	Co	0.67	Li	0.34
Er	<0.040	Ag		Fe	33		
Ho	<0.013	Pd	<0.029	Mn	2.3		

*Internal standard.
NOTE: 0.8356 g.

TABLE 2-32. SPARK SOURCE MASS SPECTROSCOPY
CAFB BITUMEN
(ppm)

U	<0.060	Dy	<0.028	Rh	<0.012	Cr	1.2
Th	<0.087	Tb	<0.007	Ru	<0.044	V	130
Bi	<0.027	Gd	<0.028	Mo	0.23	Ti	0.39
Pb	3.7	Eu	<0.012	Nb	0.014	Sc	
Tl	<0.034	Sm	<0.048	Zr	<0.019	Ca	59
Hg		Nd	<0.060	Y	<0.008	K	24
Au	<0.045	Pr	<0.011	Sr	0.33	Cl	
Pt		Ce	0.040	Rb	0.056	S	0.28 (%)
Ir	<0.069	La	<0.016	Br	<0.059	P	18
Os	<0.075	Ba	1.4	Se	1.3	Si	140
Re	<0.047	Cs	0.007	As	4.6	Al	11
W	<0.064	I	<0.041	Ge	<0.017	Mg	29
Ta		Te	<0.035	Ga	0.056	Na	19
Hf	<0.079	Sb	0.091	Zn	110	F	
Lu	<0.019	Sn	0.76	Cu	20	B	1.9
Yb	<0.027	In	15*	Ni	110	Be	0.016
Tm	<0.016	Cd	0.24	Co	0.58	Li	0.53
Er	<0.048	Ag		Fe	40		
Ho	<0.016	Pd	<0.035	Mn	2.0		

*Internal standard.
NOTE: 0.9791 g.

TABLE 2-33. SPARK SOURCE MASS SPECTROSCOPY BIOLOGICAL PLANT SLUDGE SAMPLE (ppm)

U	<0.025	Dy	<0.016	Rh	<0.010	Cr	0.071
Th	<0.023	Tb	<0.016	Ru	<0.010	V	0.025
Bi	<0.021	Gd	<0.016	Mo	0.065	Ti	0.30
Pb	0.18	Eu	<0.015	Nb	0.003	Sc	
Tl	<0.020	Sm	<0.015	Zr	0.030	Ca	2,100
Hg		Nd	<0.014	Y	0.006	K	12
Au	<0.020	Pr	<0.014	Sr	0.95	Cl	270
Pt		Ce	0.011	Rb	0.090	S	1,300
Ir	<0.019	La	<0.014	Br	3.0	P	27
Os	<0.019	Ba	0.27	Se	6.4	Si	32
Re	<0.019	Cs	0.004	As	2.5	Al	24
W	<0.018	I	<0.03	Ge	0.81	Mg	96
Ta		Te	<0.013	G	<0.021	Na	1,000
Hf	<0.018	Sb	0.014	Zn	2.0	F	26
Lu	<0.017	Sn	0.10	Cu	1.3	B	0.69
Yb	<0.017	In	*	Ni	14	Be	0.006
Tm	<0.017	Cd	0.19	Co	0.16	Li	0.23
Er	<0.017	Ag		Fe	210		
Ho	<0.016	Pd	<0.011	Mn	5.2		

*Internal standard.

TABLE 2-34. SPARK SOURCE MASS SPECTROSCOPY
10-μm CYCLONE CATCH FROM SASS-1
(ppm)

U	5.3	Dy	<2.9	Rh	<0.31	Cr	40
Th	15	Tb	<0.012	Ru	<0.083	V	91
Bi	<2.3	Gd	<1.4	Mo	2.4	Ti	0.64(%)
Pb	62	Eu	1.1	Nb	27	Sc	
Tl	<0.38	Sm	6.0	Zr	150	Ca	6.5(%)
Hg		Nd	13	Y	54	K	0.17(%)
Au	<0.099	Pr	4.1	Sr	850	Cl	
Pt		Ce	32	Rb	19	S	MC
Ir	<0.15	La	45	Br	83	P	210
Os	<0.17	Ba	660	Se	<27	Si	6.7(%)
Re	<0.11	Cs	1.9	As	200	Al	MC
W	<0.58	I	2.6	Ge	12	Mg	0.48(%)
Ta		Te	<1.6	Ga	31	Na	850
Hf	<2.5	Sb	1.8	Zn	660	F	
Lu	<1.0	Sn	5.7	Cu	97	B	340
Yb	<0.78	In	140*	Ni	46	Be	3.6
Tm	<0.30	Cd	1.5	Co	21	Li	
Er	<1.1	Ag		Fe	MC		
Ho	<0.21	Pd	<1.7	Mn	0.19(%)		

MC = Major component.
*Internal standard.
NOTE: 0.1058 g.

TABLE 2-35. SPARK SOURCE MASS SPECTROSCOPY
3-μm CYCLONE CATCH FROM SASS-1
(ppm)

U	9.8	Dy	<0.11	Rh	<0.050	Cr	25
Th	20	Tb	<0.022	Ru	<0.15	V	96
Bi	<8.4	Gd	<0.11	Mo	2.8	Ti	0.36(%)
Pb	50	Eu	<0.71	Nb	25	Sc	
Tl	<0.15	Sm	<2.8	Zr	190	Ca	9.0(%)
Hg		Nd	12	Y	36	K	0.47(%)
Au	<0.18	Pr	4.1	Sr	0.100(%)	Cl	
Pt		Ce	30	Rb	17	S	0.90(%)
Ir	<0.28	La	42	Br	54	P	730
Os	<0.31	Ba	720	Se	<6.8	Si	13(%)
Re	<0.20	Cs	1.3	As	210	Al	1.9(%)
W	<0.73	I	<0.44	Ge	<8.1	Mg	0.74(%)
Ta		Te	<0.83	Ga	58	Na	0.31(%)
Hf	<2.3	Sb	2.3	Zn	230	F	
Lu	<0.89	Sn	5.3	Cu	32	B	0.11(%)
Yb	<0.95	In	140*	Ni	85	Be	2.4
Tm	<0.068	Cd	0.98	Co	14	Li	24
Er	<0.20	Ag		Fe	1.7(%)		
Ho	<0.38	Pd	<1.6	Mn	360		

*Internal standard.
NOTE: 0.1003 g.

TABLE 2-36. SPARK SOURCE MASS SPECTROSCOPY 1-μm CYCLONE CATCH FROM SASS-1 (ppm)

U	5.6	Dy	<4.3	Rh	<0.11	Cr	65
Th	23	Tb	<0.051	Ru	<0.35	V	220
Bi	<9.7	Gd	<1.7	Mo	5.1	Ti	0.81(%)
Pb	160	Eu	<1.1	Nb	57	Sc	
Tl	<0.35	Sm	<6.4	Zr	320	Ca	9.3(%)
Hg		Nd	14	Y	83	K	0.64(%)
Au	<0.42	Pr	4.7	Sr	0.13(%)	Cl	
Pt		Ce	68	Rb	29	S	2.9(%)
Ir	<0.65	La	190	Br	89	P	910
Os	<0.71	Ba	0.25(%)	Se	<22	Si	5.1(%)
Re	<0.45	Cs	1.6	As	470	Al	1.9(%)
W	<1.7	I	<0.24	Ge	<9.8	Mg	0.6(%)
Ta		Te	<3.2	Ga	120	Na	0.16(%)
Hf	<11.	Sb	5.1	Zn	340	F	
Lu	<2.1	Sn	8.6	Cu	100	B	0.45(%)
Yb	<1.7	In	140*	Ni	140	Be	15
Tm	<0.16	Cd	1.8	Co	32	Li	55
Er	<3.2	Ag		Fe	2.2(%)		
Ho	<0.62	Pd	<1.2	Mn	450		

*Internal standard.
NOTE: 0.1030 g.

TABLE 2-37. SPARK SOURCE MASS SPECTROSCOPY XAD-2 RESIN FROM SASS-1 (ppm)

U	<0.084	Dy	<0.039	Rh	<0.017	Cr	0.42
Th	<0.12	Tb	<0.011	Ru	<0.063	V	0.094
Bi	<0.038	Gd	<0.039	Mo	<0.058	Ti	<0.31
Pb	1.3	Eu	<0.018	Nb	<0.007	Sc	
Tl	<0.047	Sm	<0.068	Zr	<0.027	Ca	43
Hg		Nd	<0.085	Y	<0.011	K	22
Au	<0.063	Pr	<0.015	Sr	0.96	Cl	
Pt		Ce	<0.020	Rb	0.028	S	570
Ir	<0.097	La	<0.022	Br	4.1	P	7.5
Os	<0.11	Ba	<0.35	Se	<0.28	Si	65
Re	<0.067	Cs	<0.003	As	0.052	Al	9.4
W	<0.090	I	<0.058	Ge	<0.023	Mg	29
Ta		Te	<0.049	Ga	<0.009	Na	110
Hf	<0.11	Sb	<0.034	Zn	7.3	F	
Lu	<0.026	Sn	0.37	Cu	12	B	1.4
Yb	<0.038	In	21*	Ni	7.1	Be	<0.006
Tm	<0.023	Cd	<0.061	Co	<0.22	Li	0.040
Er	<0.068	Ag		Fe	31		
Ho	<0.022	Pd	<0.049	Mn	0.70		

*Internal standard.
NOTE: 0.6928 g.

TABLE 2-38. SPARK SOURCE MASS SPECTROSCOPY XAD-2 RESIN BLANK FOR SASS-1 AND SASS-2 (ppm)

U	<0.25	Dy	<0.11	Rh	<0.050	Cr	0.29
Th	<0.36	Tb	<0.031	Ru	<0.18	V	0.097
Bi	<0.11	Gd	<0.11	Mo	<0.17	Ti	0.91
Pb	1.3	Eu	<0.052	Nb	<0.021	Sc	
Tl	<0.14	Sm	<0.20	Zr	<0.080	Ca	120
Hg		Nd	<0.25	Y	<0.033	K	120
Au	<0.18	Pr	<0.044	Sr	1.4	Cl	
Pt		Ce	<0.059	Rb	0.12	S	500
Ir	<0.28	La	<0.064	Br	12	P	22
Os	<0.31	Ba	<2.1	Se	0.82	Si	46
Re	<0.20	Cs	<0.010	As	<0.038	Al	16
W	<0.26	I	<0.17	Ge	<0.069	Mg	15
Ta		Te	<0.14	Ga	<0.028	Na	180
Hf	<0.33	Sb	<0.100	Zn	6.8	F	
Lu	<0.077	Sn	<0.14	Cu	8.7	B	0.38
Yb	<0.11	In	21*	Ni	11	Be	<0.001
Tm	<0.068	Cd	<0.18	Co	0.16	Li	0.060
Er	<0.20	Ag		Fe	16		
Ho	<0.066	Pd	<0.14	Mn	2.0		

*Internal standard.
NOTE: 0.6674 g from 4.1 g.

TABLE 2-39. SPARK SOURCE MASS SPECTROSCOPY COMPOSITE SAMPLE* FROM SASS-1 (ppm)

U	<0.003	Dy	<0.001	Rh	<0.001	Cr	0.15
Th	<0.004	Tb	<0.001	Ru	<0.002	V	0.005
Bi	<0.001	Gd	<0.001	Mo	<0.002	Ti	0.008
Pb	0.016	Eu	<0.001	Nb	<0.001	Sc	
Tl	<0.002	Sm	<0.002	Zr	<0.001	Ca	81
Hg		Nd	<0.003	Y	<0.001	K	0.16
Au	<0.002	Pr	<0.001	Sr	0.006	Cl	
Pt		Ce	<0.001	Rb	0.001	S	57
Ir	<0.004	La	<0.001	Br	0.017	P	0.92
Os	<0.004	Ba	0.006	Se	0.010	Si	0.30
Re	<0.002	Cs	<0.001	As	0.003	Al	0.15
W	<0.003	I	<0.002	Ge	<0.001	Mg	0.14
Ta		Te	<0.002	Ga	<0.001	Na	0.77
Hf	<0.004	Sb	<0.001	Zn	0.32	F	
Lu	<0.001	Sn	0.84	Cu	0.30	B	0.050
Yb	<0.001	In	1.8†	Ni	0.18	Be	0.000
Tm	<0.001	Cd	0.018	Co	0.006	Li	0.001
Er	<0.002	Ag		Fe	2.0		
Ho	<0.001	Pd	<0.002	Mn	0.073		

*Composite of acid module rinse, condensate, and first impinger.

†Internal standard.

NOTE: 20 mL.

TABLE 2-40. SPARK SOURCE MASS SPECTROSCOPY COMPOSITE SAMPLE BLANK† FROM SASS-1 (ppm)

U	<0.002	Dy	<0.001	Rh	<0.002	Cr	0.003
Th	<0.002	Tb	<0.001	Ru	<0.001	V	0.001
Bi	<0.001	Gd	<0.001	Mo	<0.001	Ti	0.007
Pb	0.009	Eu	<0.001	Nb	<0.001	Sc	
Tl	<0.001	Sm	<0.001	Zr	<0.001	Ca	3.0
Hg		Nd	<0.002	Y	<0.001	K	0.085
Au	<0.001	Pr	<0.001	Sr	0.002	Cl	
Pt		Ce	<0.001	Rb	0.001	S	3.6
Ir	<0.002	La	<0.001	Br	0.12	P	0.52
Os	<0.002	Ba	<0.007	Se	0.004	Si	0.13
Re	<0.001	Cs	<0.001	As	0.003	Al	0.047
W	<0.002	I	<0.001	Ge	<0.001	Mg	0.022
Ta		Te	<0.001	Ga	<0.001	Na	1.3
Hf	<0.002	Sb	<0.001	Zn	0.11	F	
Lu	<0.001	Sn	0.24	Cu	0.023	B	0.001
Yb	<0.001	In	1.8†	Ni	0.020	Be	<0.000
Tm	<0.001	Cd	0.005	Co	0.003	Li	0.001
Er	<0.001	Ag		Fe	0.22		
Ho	<0.001	Pd	<0.001	Mn	0.005		

*Composite of acid module rinse, condensate, and first impinger.

†Internal standard.

NOTE: 20 mL.

TABLE 2-41. SPARK SOURCE MASS SPECTROSCOPY 10-μm CYCLONE CATCH FROM SASS-2 (ppm)

U	6.2	Dy	<2.4	Rh	<0.35	Cr	51
Th	17	Tb	<0.028	Ru	<0.20	V	210
Bi	<3.7	Gd	<1.7	Mo	4.0	Ti	8,200
Pb	46	Eu	<1.2	Nb	32	Sc	
Tl	<0.19	Sm	<5.9	Zr	220	Ca	51,000
Hg		Nd	<22	Y	46	K	4,600
Au	<0.23	Pr	5.2	Sr	4,300	Cl	
Pt		Ce	75	Rb	44	S	150,000
Ir	<0.36	La	76	Br	140	P	930
Os	<0.39	Ba	1,400	Se	<45	Si	MC
Re	<0.25	Cs	1.7	As	780	Al	MC
W	<0.93	I	4.5	Ge	<14	Mg	9,800
Ta		Te	<1.8	Ga	74	Na	3,000
Hf	<12	Sb	8.0	Zn	2,400	F	
Lu	<3.3	Sn	7.5	Cu	110	B	2,500
Yb	<1.2	In	140*	Ni	53	Be	1.5
Tm	<0.48	Cd	0.82	Co	18	Li	54
Er	<1.8	Ag		Fe	MC		
Ho	<0.34	Pd	<2.0	Mn	2,500		

MC = Major component.
*Internal standard.
NOTE: 0.1024 g.

TABLE 2-42. SPARK SOURCE MASS SPECTROSCOPY
3-μm CYCLONE CATCH FROM SASS-2
(ppm)

U	5.5	Dy	<2.2	Rh	<0.028	Cr	14
Th	16	Tb	<0.013	Ru	<0.087	V	96
Bi	<6.7	Gd	<1.3	Mo	2.5	Ti	3,700
Pb	110	Eu	<1.1	Nb	20	Sc	
Tl	<0.086	Sm	<4.5	Zr	190	Ca	90,000
Hg		Nd	9.8	Y	20	K	2,700
Au	<0.100	Pr	3.2	Sr	1,100	Cl	
Pt		Ce	17	Rb	20	S	22,000
Ir	<0.16	La	95	Br	62	P	230
Os	<0.17	Ba	2,300	Se	<28	Si	44,000
Re	<0.11	Cs	1.0	As	120	Al	13,000
W	<1.2	I	<0.17	Ge	8.9	Mg	2,300
Ta		Te	<0.98	Ga	66	Na	1,100
Hf	<3.9	Sb	3.6	Zn	190	F	
Lu	<1.5	Sn	4.7	Cu	72	B	600
Yb	<1.1	In	140*	Ni	48	Be	0.94
Tm	<0.039	Cd	0.77	Co	16	Li	14
Er	<0.79	Ag		Fe	17,000		
Ho	<0.43	Pd	<0.89	Mn	200		

*Internal standard.
NOTE: 0.1005 g.

TABLE 2-43. SPARK SOURCE MASS SPECTROSCOPY 1-μm CYCLONE CATCH FROM SASS-2 (ppm)

U	3.9	Dy	<2.2	Rh	<0.028	Cr	420
Th	7.7	Tb	<0.012	Ru	<0.087	V	290
Bi	<0.28	Gd	<0.75	Mo	3.6	Ti	6,700
Pb	220	Eu	<0.40	Nb	56	Sc	
Tl	<2.4	Sm	1.6	Zr	270	Ca	MC
Hg		Nd	7.0	Y	57	K	2,700
Au	<0.100	Pr	6.1	Sr	1,600	Cl	
Pt		Ce	47	Rb	20	S	12,000
Ir	<0.16	La	67	Br	42	P	1,200
Os	<0.17	Ba	2,300	Se	<28	Si	70,000
Re	<0.11	Cs	2.0	As	630	Al	MC
W	<0.86	I	<0.25	Ge	50	Mg	9,900
Ta		Te	<0.98	Ga	210	Na	3,000
Hf	<2.6	Sb	13	Zn	260	F	
Lu	<0.50	Sn	13	Cu	100	B	1,100
Yb	<0.58	In	140*	Ni	70	Be	2.6
Tm	<0.45	Cd	0.95	Co	22	Li	14
Er	<0.78	Ag		Fe	31,000		
Ho	<0.22	Pd	<1.3	Mn	370		

MC = Major component.
*Internal standard.
NOTE: 0.1007 g.

TABLE 2-44. SPARK SOURCE MASS SPECTROSCOPY
XAD-2 RESIN FROM SASS-2
(ppm)

U	<0.49	Dy	<0.22	Rh	<0.098	Cr	0.54
Th	<0.70	Tb	<0.061	Ru	<0.36	V	0.064
Bi	<0.22	Gd	<0.22	Mo	<0.33	Ti	0.89
Pb	1.3	Eu	<0.100	Nb	<0.042	Sc	
Tl	<0.27	Sm	<0.39	Zr	<0.16	Ca	82
Hg		Nd	<0.49	Y	<0.065	K	49
Au	<0.36	Pr	<0.086	Sr	1.3	Cl	
Pt		Ce	<0.12	Rb	0.23	S	5,800
Ir	<0.56	La	<0.13	Br	8.2	P	22
Os	<0.61	Ba	0.48	Se	<0.19	Si	47
Re	<0.38	Cs	<0.020	As	<0.075	Al	18
W	<0.52	I	<0.34	Ge	<0.13	Mg	29
Ta		Te	<0.28	Ga	<0.055	Na	360
Hf	<0.64	Sb	<0.20	Zn	9.4	F	
Lu	<0.15	Sn	<0.28	Cu	12	B	4.2
Yb	<0.22	In	21*	Ni	20	Be	0.011
Tm	<0.13	Cd	<0.35	Co	0.15	Li	0.23
Er	<0.39	Ag		Fe	31		
Ho	<0.13	Pd	<0.28	Mn	1.1		

*Internal standard.
NOTE: 0.6787 g from 6.5 g.

TABLE 2-45. SPARK SOURCE MASS SPECTROSCOPY
COMPOSITE SAMPLE* FROM SASS-2
(ppm)

U	<0.008	Dy	<0.004	Rh	<0.002	Cr	0.12
Th	<0.012	Tb	<0.001	Ru	<0.006	V	0.002
Bi	<0.004	Gd	<0.004	Mo	0.023	Ti	0.038
Pb	<0.008	Eu	<0.002	Nb	0.002	Sc	
Tl	<0.005	Sm	<0.007	Zr	<0.003	Ca	0.84
Hg		Nd	<0.008	Y	<0.001	K	0.29
Au	<0.006	Pr	<0.001	Sr	0.004	Cl	
Pt		Ce	<0.002	Rb	0.001	S	130
Ir	<0.009	La	<0.002	Br	0.024	P	2.4
Os	<0.010	Ba	0.008	Se	0.059	Si	0.59
Re	<0.007	Cs	<0.001	As	0.002	Al	0.22
W	<0.009	I	<0.006	Ge	<0.002	Mg	0.27
Ta		Te	<0.005	Ga	<0.001	Na	2.1
Hf	<0.011	Sb	<0.003	Zn	0.18	F	
Lu	<0.003	Sn	1.1	Cu	0.29	B	0.77
Yb	<0.004	In	0.72†	Ni	0.19	Be	<0.001
Tm	<0.002	Cd	0.045	Co	0.005	Li	0.005
Er	<0.007	Ag		Fe	0.74		
Ho	<0.002	Pd	<0.005	Mn	0.036		

*Composite of acid module rinse, condensate, and first impinger.
†Internal standard.
NOTE: 20 mL.

TABLE 2-46. SPARK SOURCE MASS SPECTROSCOPY COMPOSITE SAMPLE BLANK* FROM SASS-2 (ppm)

U	<0.024	Dy	<0.011	Rh	<0.005	Cr	0.009
Th	<0.034	Tb	<0.003	Ru	<0.018	V	0.002
Bi	<0.011	Gd	<0.011	Mo	<0.016	Ti	0.021
Pb	<0.022	Eu	<0.005	Nb	<0.002	Sc	
Tl	<0.013	Sm	<0.019	Zr	<0.008	Ca	0.85
Hg		Nd	<0.024	Y	<0.003	K	0.16
Au	<0.018	Pr	<0.004	Sr	<0.004	Cl	
Pt		Ce	<0.006	Rb	<0.001	S	9.6
Ir	<0.027	La	<0.006	Br	0.13	P	2.1
Os	<0.030	Ba	<0.008	Se	<0.009	Si	2.3
Re	<0.019	Cs	<0.001	As	<0.004	Al	0.22
W	<0.025	I	<0.016	Ge	<0.006	Mg	0.21
Ta		Te	<0.014	Ga	<0.003	Na	5.9
Hf	<0.031	Sb	<0.009	Zn	1.0	F	
Lu	<0.007	Sn	1.3	Cu	0.076	B	0.025
Yb	<0.011	In	0.72†	Ni	0.38	Be	0.000
Tm	<0.006	Cd	0.039	Co	<0.001	Li	0.003
Er	<0.019	Ag		Fe	0.53		
Ho	<0.006	Pd	<0.014	Mn	0.026		

*Composite of acid module rinse, condensate, and first impinger.
†Internal standard.
NOTE: 20 mL.

TABLE 2-47. SPARK SOURCE MASS SPECTROSCOPY
CAFB LIMESTONE
(ppm)

U	<0.37	Dy	<0.20	Rh	<0.089	Cr	0.76
Th	<0.53	Tb	<0.40	Ru	<0.28	V	6.4
Bi	<0.23	Gd	<0.20	Mo	0.48	Ti	80
Pb	12	Eu	<0.14	Nb	<0.13	Sc	
Tl	<0.27	Sm	<0.43	Zr	1.2	Ca	160,000
Hg		Nd	<0.30	Y	0.52	K	220
Au	<0.33	Pr	0.22	Sr	210	Cl	
Pt		Ce	0.42	Rb	2.1	S	530
Ir	<0.51	La	1.8	Br	<18	P	39
Os	<0.55	Ba	160	Se	<4.3	Si	430
Re	<0.35	Cs	0.052	As	<0.079	Al	130
W	<0.24	I	4.5	Ge	<0.11	Mg	2,200
Ta		Te	<0.25	Ga	<0.048	Na	110
Hf	<1.2	Sb	0.96	Zn	2.1	F	
Lu	<0.29	Sn	4.7	Cu	4.7	B	17
Yb	<0.21	In	110*	Ni	14	Be	0.012
Tm	<0.12	Cd	<0.059	Co	0.58	Li	0.086
Er	<0.36	Ag		Fe	1,500		
Ho	<0.059	Pd	<0.34	Mn	8.8		

*Internal standard.
NOTE: 0.1324 g.

TABLE 2-48. SPARK SOURCE MASS SPECTROSCOPY
CAFB FINES RETURN
(ppm)

U	5.1	Dy	<2.8	Rh	<0.21	Cr	59
Th	10	Tb	<0.016	Ru	<0.11	V	120
Bi	<0.093	Gd	<0.98	Mo	2.9	Ti	8,700
Pb	27	Eu	0.52	Nb	<37	Sc	
Tl	<0.11	Sm	<3.4	Zr	180	Ca	MC
Hg		Nd	9.1	Y	26	K	3,500
Au	<0.14	Pr	4.1	Sr	900	Cl	
Pt		Ce	44	Rb	26	S	9,400
Ir	<0.21	La	44	Br	110	P	540
Os	<0.23	Ba	910	Se	<19	Si	MC
Re	<0.14	Cs	1.9	As	270	Al	MC
W	<0.54	I	0.45	Ge	<2.9	Mg	5,000
Ta		Te	<0.74	Ga	21	Na	640
Hf	<2.5	Sb	3.3	Zn	<0.041	F	
Lu	<1.4	Sn	5.5	Cu	47	B	160
Yb	<0.70	In	190.0*	Ni	21	Be	0.30
Tm	<0.14	Cd	0.45	Co	10	Li	3.1
Er	<1.0	Ag		Fe	41,000		
Ho	0.20	Pd	<0.79	Mn	260		

MC = Major component.
*Internal standard.
NOTE: 0.0769 g.

TABLE 2-49. SPARK SOURCE MASS SPECTROSCOPY
CAFB BOILER BACK
(ppm)

U	4.1	Dy	<2.2	Rh	<0.029	Cr	25
Th	16	Tb	<0.013	Ru	<0.091	V	100
Bi	<0.074	Gd	<0.67	Mo	1.9	Ti	3,800
Pb	29	Eu	<0.77	Nb	59	Sc	
Tl	<0.85	Sm	<4.7	Zr	200	Ca	71,000
Hg		Nd	15	Y	30	K	5,100
Au	<0.11	Pr	4.5	Sr	1,100	Cl	
Pt		Ce	35	Rb	21	S	7,500
Ir	<0.17	La	49	Br	46	P	230
Os	<0.18	Ba	430	Se	<15	Si	MC
Re	<0.12	Cs	3.0	As	120	Al	MC
W	<0.90	I	<0.12	Ge	<4.8	Mg	3,500
Ta		Te	<0.83	Ga	34	Na	960
Hf	<5.4	Sb	1.8	Zn	62	F	
Lu	<0.77	Sn	6.3	Cu	75	B	210
Yb	<0.43	In	150*	Ni	50	Be	0.49
Tm	<0.33	Cd	0.77	Co	5.7	Li	14
Er	<1.7	Ag		Fe	33,000		
Ho	<0.45	Pd	<1.3	Mn	210		

MC = Major component.
*Internal standard.
NOTE: 0.0961 g.

TABLE 2-50. SPARK SOURCE MASS SPECTROSCOPY
CAFB BOILER SIDES
(ppm)

U	14	Dy	<5.4	Rh	<0.59	Cr	120
Th	20	Tb	<0.023	Ru	<0.16	V	290
Bi	<0.72	Gd	<1.9	Mo	31	Ti	2,100
Pb	71	Eu	<1.0	Nb	73	Sc	
Tl	<1.5	Sm	<5.7	Zr	640	Ca	MC
Hg		Nd	18	Y	51	K	4,800
Au	<0.19	Pr	5.7	Sr	1,100	Cl	
Pt		Ce	60	Rb	36	S	7,000
Ir	<0.29	La	85	Br	79	P	410
Os	<0.31	Ba	1,100	Se	<9.7	Si	MC
Re	<0.20	Cs	5.3	As	370	Al	MC
W	<1.6	I	<0.63	Ge	<23	Mg	7,000
Ta		Te	<2.5	Ga	59	Na	830
Hf	<39	Sb	6.8	Zn	100	F	
Lu	<1.3	Sn	12	Cu	92	B	280
Yb	<1.4	In	150*	Ni	1,400	Be	0.59
Tm	<0.069	Cd	4.0	Co	28	Li	25
Er	<2.1	Ag		Fe	MC		
Ho	<0.78	Pd	<6.7	Mn	2,000		

MC = Major component.
*Internal standard.
NOTE: 0.0982 g.

TABLE 2-51. SPARK SOURCE MASS SPECTROSCOPY
CAFB LIMESTONE FEED
(ppm)

U	<0.63	Dy	<0.26	Rh	<0.12	Cr	0.63
Th	<0.63	Tb	<0.07	Ru	<0.43	V	3.6
Bi	<0.28	Gd	<0.28	Mo	0.87	Ti	40
Pb	8.3	Eu	<0.12	Nb	<0.05	Sc	
Tl	<0.33	Sm	<0.48	Zr	0.55	Ca	MC
Hg		Nd	<0.50	Y	0.24	K	230
Au	<0.43	Pr	0.21	Sr	210	Cl	
Pt	<1.2	Ce	0.43	Rb	1.7	S	400
Ir	<0.65	La	0.95	Br	<21	P	27
Os	<0.74	Ba	160	Se	<4.4	Si	400
Re	<0.46	Cs	0.06	As	<328	Al	150
W	<0.61	I	19	Ge	<0.17	Mg	3,600
Ta		Te	<0.35	Ga	<0.07	Na	110
Hf	<0.75	Sb	0.95	Zn	<1.4	F	150
Lu	<0.17	Sn	5.5	Cu	3.8	B	5.5
Yb	<0.27	In	15*	Ni	4.4	Be	0.003
Tm	<0.16	Cd		Co	0.23	Li	0.09
Er	<0.46	Ag		Fe	590		
Ho	<0.15	Pd	<0.34	Mn	7.5		

MC = Major component.

*Internal standard.

TABLE 2-52. SPARK SOURCE MASS SPECTROSCOPY
CAFB LIGNITE*
(ppm)

U	1.2	Dy	<0.26	Rh	<0.064	Cr	13
Th	3.8	Tb	<0.16	Ru	<0.23	V	28
Bi	<0.33	Gd	<0.43	Mo	0.73	Ti	1,400
Pb	13	Eu	<0.12	Nb	6.9	Sc	
Tl	<0.47	Sm	<0.73	Zr	65	Ca	MC
Hg		Nd	1.1	Y	8.2	K	4,900
Au	<0.23	Pr	1.4	Sr	230	Cl	
Pt	<0.64	Ce	3.4	Rb	7.8	S	8,600
Ir	<0.35	La	10	Br	11	P	76
Os	<0.40	Ba	320	Se	<9.3	Si	MC
Re	<0.25	Cs	0.86	As	<57	Al	MC
W	<0.60	I	0.16	Ge	<3.0	Mg	4,400
Ta		Te	4.9	Ga	14	Na	80
Hf	<0.75	Sb	0.38	Zn	11	F	92
Lu	<0.17	Sn	1.9	Cu	19	B	88
Yb	<0.27	In	IS†	Ni	10	Be	0.55
Tm	<0.16	Cd	0.69	Co	2.2	Li	
Er	<0.25	Ag		Fe	5,700		
Ho	<0.15	Pd	<0.18	Mn	100		

MC = Major component.

*Concentrations based on "as received" lignite weight.

†Internal standard.

TABLE 2-53. ATOMIC ABSORPTION ANALYSIS
CAFB-LIGNITE STUDY
(µg/g)

Sample	As	Hg	Sb
Gasifier bed		0.037	
Main cyclone		0.029	
Regenerator bed		0.029	
Regenerator cyclone		0.054	
Stack cyclone		0.129	
Stack knockout baffle		0.833	
Lignite		0.158	

TABLE 2-54. ATOMIC ABSORPTION ANALYSIS
CAFB-LIGNITE PROCESS*
SASS RUN #1
(ppm)

Sample	As	Hg	Sb
Filter		1.24	
1-μm cyclone		0.80	
3-μm cyclone		0.70	
10-μm cyclone		1.12	
XAD		<0.072	
CH†		0.014	
IC‡		0.003	

ND = Not detected; sample is less than or equal to blank.
*All values blank-corrected.
†Combination of first impinger, condensate, and acid module rinse.
‡Combination of second and third impingers.

TABLE 2-55. ATOMIC ABSORPTION ANALYSIS
CAFB-LIGNITE PROCESS*
SASS RUN #2
(ppm)

Sample	As	Hg	Sb
Filter		12.67	
1-μm cyclone		1.87	
3-μm cyclone		1.19	
10-μm cyclone		0.79	
XAD		<0.081	
CH†		0.034	
IC‡		0.003	

ND = Not detected; sample is less than or equal to blank.
*All values blank-corrected.
†Combination of first impinger, condensate, and acid module rinse.
‡Combination of second and third impingers.

TABLE 2-56. ATOMIC ABSORPTION ANALYSIS VENTURI SCRUBBER (μg/m³)

Sample	As	Hg	Sb
Probe + cyclone rinse	-	<0.004	-
10- + 3-μm particulates	-	<0.02	-
1-μm + filter particulates	-	<0.002	-
XAD-2	-	<0.3	-
Condensate + 1st impinger	-	<0.21	-
2nd + 3rd impinger	<0.03	<0.04	<0.4

TABLE 2-57. ATOMIC ABSORPTION ANALYSIS TCA SCRUBBER (μg/m³)

Sample	As	Hg	Sb
Probe + cyclone rinse	-	<0.004	-
10- + 3-μm particulates	-	<0.004	-
1-μm + filter particulates	-	<0.003	-
XAD-2	-	<0.3	-
Condensate + 1st impinger	-	<0.006	-
2nd + 3rd impinger	<0.03	0.38	<0.4

TABLE 2-58. ATOMIC ABSORPTION ANALYSIS OXIDATION TANK VENT (μg/m³)

Sample	As	Hg	Sb
Probe + cyclone rinse	-	*	-
10- + 3-μm particulates	-	*	-
1-μm + filter particulates	-	<0.002	-
XAD-2	-	<0.03	-
Condensate + 1st impinger	-	<0.04	-
2nd + 3rd impinger	<0.03	<0.04	<0.4

*Oxidation tank vent stream did not contain a significant particulate loading.

TABLE 2-59. ATOMIC ABSORPTION ANALYSIS SCRUBBER SAMPLES (μg/g)

Sample	As	Hg	Sb
Venturi filter cake	NR	0.09	NR
Venturi spray tower slurry (liquid)	NR	0.9*	NR
Venturi spray tower slurry (solids)	NR	0.06[†] (5.0*)*	NR
TCA centrifuge cake	NR	0.03	NR

NR = None reported.
*μg/L.
[†] Based on solid content of 78.8 g/L.

TABLE 2-60. FIXED GASES CAFB GAS ANALYSIS (ppmv)

Sample test date	O_2	CO_2	CO	N_2
1/24	9.1	10.1	<0.05	
1/25	9.0	6.1	<0.05	
1/27	5.3	6.4	<0.05	

TABLE 2-61. NITROGEN OXIDES CAFB GAS ANALYSIS (ppmv)

Sample test date	NO	NO_x
1/24	28	33
1/25	14.5	15.7
1/27	26	42

TABLE 2-62. SULFUR SPECIES CAFB GAS ANALYSIS (ppmv)

Sample test date	COS	H_2S	SO_2	SO_3
1/24			101.9	0.8
1/26			299.7	1.3
1/27			185.0	0.9

TABLE 2-63. FIXED GASES
CAFB PILOT PLANT
(μg/m³)

	O_2	CO_2	CO	N_2
Flue gas		140,000,000	<57,000	

TABLE 2-64. SULFUR GASES
CAFB PILOT PLANT
(μg/m³)

	COS	H_2S	SO_2	SO_3
Flue gas			510,000	3,200

TABLE 2-65. NITROGEN GASES
CAFB PILOT PLANT
(μg/m³)

	NO	NO_x
Flue gas	37,000	28,000

TABLE 2-66. ANION ANALYSIS
CAFB-LIGNITE STUDY
(ppm)

Sample	F^-	Cl^-	NO_3^-	$SO_4^=$
Gasifier bed	80	2,000		1,200
Main cyclone	130	780		1,000
Regenerator bed	90	140		2,200
Regenerator cyclone	210	2,000		1,800
Stack cyclone	150	54		2,000
Stack knockout baffle	190	200		3,400
Lignite	90	1,750		18,000

TABLE 2-67. ANION ANALYSIS
CAFB-LIGNITE PROCESS*
SASS RUN #1
(ppm)

Sample	F^-	Cl^-	NO_3^-	$SO_4^=$
Filter	590	ND		59,000
1-μm cyclone	420	5		8,200
3-μm cyclone	90	100		7,400
10-μm cyclone	350	-		75,000
XAD	20	ND		1,800
CH†	50	8		-
IC‡	-	-		-

ND = Not detected; sample is less than or equal to blank.
*All values blank-corrected.
†Combination of first impinger, condensate, and acid module rinse.
‡Combination of second and third impingers.

TABLE 2-68. ANION ANALYSIS
CAFB-LIGNITE PROCESS*
SASS RUN #2
(ppm)

Sample	F^-	Cl^-	NO_3^-	$SO_4^=$
Filter	590	ND		110,000
1-μm cyclone	420	5		220,000
3-μm cyclone	90	100		210,000
10-μm cyclone	350	-		740,000
XAD	20	ND		320
CH†	50	8		-
IC‡	-	-		-

ND = Not detected; sample is less than or equal to blank.
*All values blank-corrected.
†Combination of first impinger, condensate, and acid module rinse.
‡Combination of second and third impingers.

TABLE 2-69. GAS CHROMATOGRAPHY ANALYSIS
CAFB GAS ANALYSIS
1/24

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		21.4	
GC2*		2.8	
GC3			
GC4			
GC5			
GC6			
GC7			

*No hydrocarbons above C_2 detected, MDL 0.5 ppmv.

TABLE 2-70. GAS CHROMATOGRAPHY ANALYSIS
CAFB GAS ANALYSIS
1/25

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		6.5	
GC2*		<0.5	
GC3			
GC4			
GC5			
GC6			
GC7			

*No hydrocarbons above C_2 detected, MDL 0.5 ppmv.

TABLE 2-71. GAS CHROMATOGRAPHY ANALYSIS
CAFB GAS ANALYSIS

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		<0.5	
GC2*		<0.5	
GC3			
GC4			
GC5			
GC6			
GC7			

*No hydrocarbons above C_2 detected, MDL 0.5 ppmv.

TABLE 2-72. GAS CHROMATOGRAPHY ANALYSIS TOTAL CAFB ORGANIC EMISSIONS SASS #1

Gas	Range	Volatile weight, ppm	No. of peaks
GC1			
GC2			NR
GC3			
GC4		17,770 - 23,192	
GC5			
GC6			
GC7			

NR = Not reported.

TABLE 2-73. GAS CHROMATOGRAPHY ANALYSIS TOTAL CAFB ORGANIC EMISSIONS SASS #2

Gas	Range	Volatile weight, ppm	No. of peaks
GC1			
GC2			
GC3			
GC4		No data	NR
GC5			
GC6			
GC7			

NR = Not reported.

TABLE 2-74. GAS CHROMATOGRAPHY ANALYSIS TOTAL CAFB ORGANIC EMISSIONS SASS #1

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110		
GC8	110-140		NR
GC9	140-160	221	
GC10	160-180		
GC11	180-200		
GC12	200-220		
GC13			
GC14			
GC15			
GC16			
>GC16		565	

NR = Not reported.

TABLE 2-75. GAS CHROMATOGRAPHY ANALYSIS TOTAL CAFB ORGANIC EMISSIONS SASS #2

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110		
GC8	110-140		
GC9	140-160		NR
GC10	160-180	307	
GC11	180-200		
GC12	200-220		
GC13			
GC14			
GC15			
GC16			
>GC16		21,725	

NR = Not reported.

TABLE 2-76. GAS CHROMATOGRAPHY ANALYSIS

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		0.009	
GC2		0.002	
GC3			
GC4			
GC5			
GC6			
GC7			

TABLE 2-77. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
10-μm CYCLONE

		Volatile weight, μg/m^3	
Gas	Range	Run no. 1	Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	NR	NR
GC9	140-160	2.49	6.31
GC10	160-180	1.07	NR
GC11	180-200	NR	NR
GC12	200-220	NR	NR
GC13		NR	NR
GC14		NR	NR
GC15		NR	NR
GC16		NR	NR
GC17			

NR = Not reported.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-78. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
3-μm CYCLONE

		Volatile weight, μg/m³	
Gas	Range	Run no. 1	Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	NR	NR
GC9	140-160	7.44	31.1
GC10	160-180	1.90	NR
GC11	180-200	NR	NR
GC12	200-220	NR	NR
GC13		NR	NR
GC14		NR	NR
GC15		NR	NR
GC16		NR	NR
GC17			

NR = Not reported.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-79. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
1-μm CYCLONE

		Volatile weight, μg/m³	
Gas	Range	Run no. 1	Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	NR	NR
GC9	140-160	5.78	6.24
GC10	160-180	2.98	NR
GC11	180-200	NR	NR
GC12	200-220	NR	NR
GC13		0.624	NR
GC14		NR	NR
GC15		NR	14.6
GC16		NR	NR
GC17			

NR = Not reported.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-80. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
PARTICULATE FILTER

Gas	Range	Volatile weight, µg/m³	
		Run no. 1	Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	NR	NR
GC9	140-160	NR	NR
GC10	160-180	NR	NR
GC11	180-200	NR	NR
GC12	200-220	0.599	NR
GC13		2.66	NR
GC14		NR	NR
GC15		5.39	NR
GC16		4.69	NR
GC17			

NR = Not reported.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-81. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
PROBE RINSE

Gas	Range	Volatile weight, µg/m³	
		Run no. 1	Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	4.66	NR
GC9	140-160	NR	NR
GC10	160-180	NR	0.659
GC11	180-200	NR	0.838
GC12	200-220	NR	NR
GC13		NR	NR
GC14		NR	NR
GC15		0.131	2.86
GC16		NR	NR
GC17			

NR = Not reported.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-82. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
XAD-2 RESIN

Gas	Range	Volatile weight, μg/m³	
		Run no. 1	Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	11.2	NR
GC9	140-160	2.00	NR
GC10	160-180	22.5	BR
GC11	180-200	BR	BR
GC12	200-220	22.8	BR
GC13		4.57	NR
GC14		7.06	NR
GC15		1.26	BR
GC16		3.60	
GC17			

NR = Not reported.
BR = Blank removes; sample less than or equal to blank.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-83. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
MODULE RINSE

Gas	Range	Volatile weight, μg/m³	
		Run no. 1	Run no. 2
GC7*	90-110	NR	19.4
GC8	110-140	8.95	6.20
GC9	140-160	NR	NR
GC10	160-180	NR	NR
GC11	180-200	NR	NR
GC12	200-220	NR	NR
GC13		NR	4.12
GC14		NR	NR
GC15		NR	28.3
GC16		NR	NR
GC17			

NR = Not reported.
*Not usually included in TCO range; i.e., C_8-C_{16}.
NOTE: No information was reported concerning the number of peaks.

TABLE 2-84. GAS CHROMATOGRAPHY ANALYSIS
CAFB SASS SAMPLES
CONDENSATE

Gas	Range	Volatile weight, µg/m^3 Run no. 1	Volatile weight, µg/m^3 Run no. 2
GC7*	90-110	NR	NR
GC8	110-140	4.88	9.62
GC9	140-160	91.4	158
GC10	160-180	NR	NR
GC11	180-200	NR	NR
GC12	200-220	0.232	NR
GC13		NR	NR
GC14		NR	NR
GC15		NR	18.4
GC16		NR	NR
GC17			

NR = Not reported.

*Not usually included in TCO range; i.e., C_8-C_{16}.

NOTE: No information was reported concerning the number of peaks.

TABLE 2-85. CAFB PARTICULATE MASS AND SIZE EMISSIONS DATA MEASURED BY SASS TRAIN

SASS-1

Parameter	Rate or value
Flue gas flow rate	1100.3 dscfm
Temperature at sampling port	214° F
Flue gas moisture	10.0%
Total particulate loading	0.9632 gr/dscf

Particle size fraction collected (μm)	Percent of total particulates
<1 (filter)	1.2
>1	26.9
>3	50.3
>10	21.6

SASS-2

Parameter	Rate or value
Flue gas flow rate	1271.6 dscfm
Temperature at sampling port	214° F
Flue gas moisture	12.0%
Total particulate loading	1.1994 gr/dscf

Particle size fraction collected (μm)	Percent of total particulates
<1 (filter)	1.8
>1	31.8
>3	44.1
>10	22.4

TABLE 2-86. GAS CHROMATOGRAPHY ANALYSIS VENTURI SCRUBBER (mg/m^3)

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		0.8	1
GC2		1.1	1
GC3		ND	0
GC4		ND	0
GC5		0.4	1
GC6		0.6	2
GC7		2.4	2

ND = Not detected. Estimated minimum detectable concentration is 0.05 mg/m^3.

TABLE 2-87. GAS CHROMATOGRAPHY ANALYSIS OXIDATION TANK VENT (mg/m^3)

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		1.2	1
GC2		2.1	1
GC3		ND	0
GC4		ND	0
GC5		0.1	1
GC6		0.3	1
GC7		1.7	2

ND = Not detected. Estimated minimum detectable concentration is 0.05 mg/m^3.

TABLE 2-88. GAS CHROMATOGRAPHY ANALYSIS TCA SCRUBBER (mg/m^3)

Gas	Range	Volatile weight, ppm	No. of peaks
GC1		0.9	1
GC2		0.9	1
GC3		ND	0
GC4		ND	0
GC5		ND	0
GC6		0.3	1
GC7		1.7	2

ND = Not detected. Estimated minimum detectable concentration is 0.05 mg/m^3.

TABLE 2-89. GAS CHROMATOGRAPHY ANALYSIS SPENT STONE FROM REGENERATOR

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110		
GC8	110-140	NR	
GC9	140-160	NR	
GC10	160-180	NR	
GC11	180-200	NR	
GC12	200-220	NR	
GC13		NR	
GC14		0.60	
GC15		NR	
GC16		0.2	
GC17			

NR = Not reported.

TABLE 2-90. TCO AND GRAV VALUES FOR ORGANIC SAMPLE
CAFB SASS Samples, Run No. 2
10-μm cyclone

	TCO mg/m³	GRAV mg/m³	TCO + GRAV Total mg	Concentration -mg/ (m³, L, or kg)[5]
Total sample[1]	0.00631	0.0801		0.0864
Taken for LC[2]				
Recovered[3]				

3-μm cycle

	TCO mg/m³	GRAV mg/m³	TCO + GRAV Total mg	Concentration -mg/ (m³, L, or kg)[5]
Total sample[1]	0.0311	0.303		0.334
Taken for LC[2]				
Recovered[3]				

1-μm cyclone

	TCO mg/m³	GRAV mg/m³	TCO + GRAV Total mg	Concentration -mg/ (m³, L, or kg)[5]
Total sample[1]	0.0208	0.102		0.123
Taken for LC[2]				
Recovered[3]				

Note: Data can be converted from mg/m³ to mg by multiplying the given number by

$$\frac{266.291 \text{ dscf}}{35.315 \text{ ft}^3/\text{m}^3}.$$

TABLE 2-91. TCO AND GRAV VALUES FOR ORGANIC SAMPLE
CAFB SASS Samples, Run No. 2

Particulate filter

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	--	*		*
Taken for LC[2]				
Recovered[3]				

Probe rinse

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	0.00435	*		0.00435
Taken for LC[2]				
Recovered[3]				

XAD-2 resin

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	*	3.240†		3.240†
Taken for LC[2]				
Recovered[3]				

*Blank removes; sample less than or equal to blank.

†Only the first three digits are significant.

Note: Data can be converted from mg/m^3 to mg by multiplying the given number by

$$\frac{266.291 \text{ dscf}}{35.315 \text{ ft}^3/\text{m}^3} .$$

TABLE 2-92. TCO AND GRAV VALUES FOR ORGANIC SAMPLE
CAFB SASS Samples, Run No. 2
Module rinse

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)^5
Total sample[1]	0.0580	18.000†		18.100†
Taken for LC[2]				
Recovered[3]				

Condensate

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)^5
Total sample[1]	0.186	*		0.186
Taken for LC[2]				
Recovered[3]				

*Blank removes; sample less than or equal to blank.

†Only the first three digits are significant.

Note: Data can be converted from mg/m^3 to mg by multiplying the given number by

$$\frac{266.291 \text{ dscf}}{35.315 \text{ ft}^3/\text{m}^3} .$$

TABLE 2-93. TCO AND GRAV VALUES FOR ORGANIC SAMPLE
CAFB SASS Samples, Run No. 1
10-µm cyclone

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	0.00356	*		0.00356
Taken for LC[2]				
Recovered[3]				

3-µm cycle

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	0.00934	*		0.00934
Taken for LC[2]				
Recovered[3]				

1-µm cyclone

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	0.00938	*		0.00938
Taken for LC[2]				
Recovered[3]				

*Blank removes; sample less than or equal to blank.

Note: Data can be converted from mg/m^3 to mg by multiplying the given number by

$$\frac{919.167\ \text{dscf}}{35.315\ \text{ft}^3/\text{m}^3} .$$

TABLE 2-94. TCO AND GRAV VALUES FOR ORGANIC SAMPLE
CAFB SASS Samples, Run No. 1

Particulate filter

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)^5
Total sample[1]	0.0133	0.0287		0.0420
Taken for LC[2]				
Recovered[3]				

Probe rinse

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)^5
Total sample[1]	0.00479	*		0.00479
Taken for LC[2]				
Recovered[3]				

XAD-2 resin

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)^5
Total sample[1]	0.0750	0.467		0.542
Taken for LC[2]				
Recovered[3]				

*Blank removes; sample less than or equal to blank.

Note: Data can be converted from mg/m^3 to mg by multiplying the given number by

$$\frac{919.167 \text{ dscf}}{35.315 \text{ ft}^3/\text{m}^3} .$$

TABLE 2-95. TCO AND GRAV VALUES FOR ORGANIC SAMPLE
CAFB SASS Samples, Run No. 1

Module rinse

	TCO mg/m³	GRAV mg/m³	TCO + GRAV Total mg	Concentration -mg/ (m³, L, or kg)[5]
Total sample[1]	0.00895	0.0693		0.0783
Taken for LC[2]				
Recovered[3]				

Condensate

	TCO mg/m³	GRAV mg/m³	TCO + GRAV Total mg	Concentration -mg/ (m³, L, or kg)[5]
Total sample[1]	0.0965	*		0.0965
Taken for LC[2]				
Recovered[3]				

*Blank removes; sample less than or equal to blank.

Note: Data can be converted from mg/m³ to mg by multiplying the given number by

$$\frac{919.167 \text{ dscf}}{35.315 \text{ ft}^3/\text{m}^3} .$$

TABLE 2-96. TCO AND GRAV VALUES FOR ORGANIC SAMPLE TOTAL ORGANIC EMISSIONS (C_7-C_{16})

SASS Run #1

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	0.221	0.565		0.786
Taken for LC[2]				
Recovered[3]				

SASS RUN #2

	TCO mg/m^3	GRAV mg/m^3	TCO + GRAV Total mg	Concentration -mg/ (m^3, L, or kg)[5]
Total sample[1]	0.307	21.725		22.032
Taken for LC[2]				
Recovered[3]				

Note: Data can be converted from mg/m^3 to mg by multiplying the given number by

$$\frac{919.167 \text{ dscf}}{35.315 \text{ ft}^3/\text{m}^3} .$$

TABLE 2-97

LC FRACTIONATION

SAMPLE: Spent stone from regenerator

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]	0.80 mg/kg*	195 mg/kg*		196
Taken for LC[c]				
Recovered[d]				

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
1				
2				
3				
4				
5				
6				
7				

*Note that units were reported in mg/kg, rather than mg as specified for Level 1 procedures.

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

2-98

TABLE 2-98
IR REPORT

SAMPLE: SASS run #1, condensate (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	medium	aliphatic hydrocarbons
NR	minor	esters,* ketones,*
		possible: ethers,* organosilicon compounds,
		nitrocompounds, substituted aromatics

OTHER REMARKS:

*May be saturated, unsaturated, aryl.

NR = not reported.

2-97

TABLE 2-99
IR REPORT

SAMPLE: SASS run #1, module rinse (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	minor	esters*
NR	trace	possible: aliphatic ethers

OTHER REMARKS:

*May be saturated, unsaturated, aryl.

NR = not reported.

2-100

TABLE 2-100
IR REPORT

SAMPLE: SASS run #1, 1 μ cyclone (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	minor	saturated esters
		saturated hydrocarbons
NR	trace	possible: aryl or unsaturated esters or ethers

OTHER REMARKS:

NR = not reported.

2-101

TABLE 2-101
IR REPORT

SAMPLE: SASS run #1, 3 μ cyclone (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	trace	saturated esters,
		possible: aryl or unsaturated esters or
		ethers, organosilicon compounds

OTHER REMARKS:

NR = not reported.

2-102

TABLE 2-102
IR REPORT

SAMPLE: SASS Run #2, XAD-2 resin (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	medium	Aryl or unsaturated esters
		Ketones*
		Hydrocarbons
NR	minor	Possible:
		Nitro compounds
		Ethers

OTHER REMARKS:

*May be saturated, unsaturated, and/or aryl.

NR = not reported.

2-103

TABLE 2-103
IR REPORT

SAMPLE: SASS run #2, module rinse (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	minor	aliphatic hydrocarbons
		esters*
		possible:
		aromatic hydrocarbons
NR	trace	saturated ketones,
		possible: ethers

OTHER REMARKS:

*May be saturated, unsaturated, and/or aryl.
NR = not reported.

2-104

TABLE 2-104
IR REPORT

SAMPLE: SASS run #2, condensate (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	trace	aliphatic ethers

OTHER REMARKS:

NR = not reported.

2-105

TABLE 2-105
IR REPORT

SAMPLE: SASS run #2, probe rinse (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	medium	saturated hydrocarbons, saturated esters
	minor	aryl esters,
		possible: substituted aromatics,
		aliphatic ethers

OTHER REMARKS:

NR = not reported.

The blank removed the IR Spectrum in the following samples:

SASS run no. 1, probe rinse
SASS run no. 1, particulate filter
SASS run no. 1, 10 μ cyclone

SASS run no. 2, particulate filter
SASS run no. 2, 1 μ cyclone
SASS run no. 2, 3 μ cyclone
SASS run no. 2, 10 μ cyclone

2-106

TABLE 2-106

IR REPORT

SAMPLE: 2-MR, LC Fractionation (GRAV Residue of SASS Run 2 Module Rinse and its LC Fractions)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	Minor	aliphatic hydrocarbons
NR	Minor	esters (saturated, unsaturated, aryl)
NR	Minor	aromatic hydrocarbons (possible)
NR	Trace	saturated ketones
NR	Trace	ethers (possible)
		LC Fraction
NR	Trace	1 aliphatic hydrocarbons
		2*
		3*
NR	Medium	4 esters (saturated)
NR	Minor	esters (unsaturated, aryl)
NR	Trace	ethers (possible)
NR	Minor	5 esters (saturated)
NR	Trace	esters (unsaturated, aryl)
NR	Minor	6 esters (saturated)
		esters (unsaturated, aryl)
NR	Trace	7 ethers (saturated)

NR = not reported

* Blank removes IR spectrum

OTHER REMARKS:

TABLE 2-107

IR REPORT

2-107

SAMPLE: XAD-2 Resin,* LC fractionation
(GRAV Residue of XAD-2 Resin Extract, SASS Run #2)

Page 1 of 2

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	Medium	Aryl or unsaturated esters;
NR	Medium	Ketones[+]
NR	Medium	Hydrocarbons
NR	Minor	Nitro-compounds (possible)
NR	Minor	Ethers (possible)
		LC fraction
NR	Medium	1 aliphatic hydrocarbons
NR	Minor	aromatic hydrocarbons
NR	Trace	esters (aryl or unsaturated)
NR	Trace	ethers (possible)
NR	Trace	2 hydrocarbons[+]
NR	Trace	saturated ethers (possible)
NR	Minor	3 esters
NR	Trace	saturated hydrocarbons (possible)
	Trace	ethers
		4 §
		5 §
NR	Major	6 esters
NR	Major	ketones
NR	Medium	amines (possible)
NR	Medium	alcohols/phenols (possible)
NR	Medium	ethers (possible
NR	Medium	nitrocompounds (possible)
NR	Medium	amines (possible)

OTHER REMARKS:

(continued)

2-108

TABLE 2-107 (continued)

IR REPORT

SAMPLE: XAD-2 Resin,* LC Fractionation

(GRAV Residue of XAD-2 Resin Extract, SASS Run #2) Page 2 of 2

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC Fraction
NR	Medium	7 unsaturated esters
NR	Medium	saturated and unsaturated ketones
NR	Minor	8 ethers (possible)
NR	Minor	nitrocompounds (possible)
NR = not detected		

OTHER REMARKS:

*The spectra of some fractions are stronger than the spectrum of the unfractionated sample. Therefore, some compounds may show up in the spectrum of a fraction, but not in the spectrum of the unfractionated sample.

†May be saturated, unsaturated, and/or aryl.

§Blank removes IR spectra.

2-109

TABLE 2-108
IR REPORT

SAMPLE: Spent stone from regenerator

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	Minor	Aryl and unsaturated esters and ethers

OTHER REMARKS:

NR = Not reported.

TABLE 2-109

IR REPORT

SAMPLE: SASS run #1, XAD-2 resin (IR spectra from GRAV residue of unfractionated sample)

Wave Number (cm^{-1})	Intensity	Assignment/Comments
NR	medium	esters,*
		saturated hydrocarbons
NR	minor	possible nitrosubstituted compounds, ethers

OTHER REMARKS:

*May be saturated, unsaturated, aryl.

NR = not reported.

TABLE 2-110. SUMMARY OF TRACE ELEMENT DATA

Trace element	Lignite fuel feed data (ppm)			Flue gas emissions ($\mu g/m^3$)				Solid basis (ppm)		
				CAFB		Site A	Site B	CAFB		Site A
	CAFB 1197	Site A	Site B	SASS-1	SASS-2			SASS-1	SASS-2	
Pb	9.6	1.7	2.3	200	310	320	1.1 to 8.5	90.5	113	37.7
Ba	38	110	7.0	2,800	5,100	200,000	<28	1,268	1,018	23,585
Sb	0.30	0.055	<0.22	7.2	18	40	< 0.5	3.3	2.6	4.7
Cd	0.17	0.28	<0.39	5.4	15	33	0.9 to 2.1	2.4	2.0	3.9
Zr	5.9	0.37	0.35	510	540	1,300	0.3	231	196	153
Sr	37	38	46	2,600	5,000	41,000	<10	1,177	1,818	4,835
Br	0.23	3.3	3.2	160	190	210	<43	72.4	69.1	24.8
As	1.5	2.6	0.48	650	1,000	1,600	< 4.2	294	364	189
Zn	13	10	15.0	860	1,900	880	13 to 31	389	691	104
Cu	15	62	7.1	180	260	470	<36	81.5	94.6	55.4
Ni	23	4	48	230	380	1,400	<69	104	138	165
Cr	2.7	0.48	0.61	110	330	470	< 4.2	49.8	120	55.4
V	14	0.56	0.87	310	430	470	< 1.1	140	156	55.4
Ti	230	9.3	15.0	13,000	14,000	28,000	< 3.5	5,885	5,091	3,302
S	0.23%	0.23%	1.4%	-	220,000	160,000	1400 to 7700	-	80,000	18,868
P	42	14	8.6	1,600	1,600	16,000	<46	724	582	1,887
Si	MC	170	420	230,000	-	-	180	104,100	-	-
Mg	130%	420	840	16,000	15,000	MC	160	7,243	5,455	-
B	21	6.3	8.9	4,300	3,100	140,000	64	1,946	1,127	16,509
Be	0.03	0.018	0.037	14	3.8	10	0.2	6.3	1.4	1.2
Li	0.82	0.26		ND	60	570	<0.3		21.8	67.2
Co	0.50	0.089	0.17	48	44	100	<0.8			
Mn	22	11.0	13.0	1,700	2,000	27,000	<7.8			

Note: ND = not determined; MC = major component.

ADDITIONAL DATA

TABLE 3. CAFB PARTICULATE TEST DATA

Test No.	Date	Q_s[*] (dscfm)	Q_a[†] (acfm)	Moisture (%)	E.A.[‡] (%)	Part. loading (gr/dscf)	V_{mstd}[§] (dscf)	Test design
RAC-1	1/24	1200.7	1463.3	7.1	39.9	1.0381	29.525	Part.; SO_2/SO_3
SASS-1	1/24	1100.3	1590.0	10.0	53.6	0.9632	919.167	SASS
RAC-2	1/25	1388.1	1891.6	6.6	67.1	1.5291	32.740	Part.; organics
SASS-2	1/26	1271.6	1878.0	12.1	53.6	1.1994	266.291	SASS
RAC-3	1/26	1346.7	1844.6	9.0	53.6	0.9906	32.876	Part.; SO_2/SO_3
RAC-4	1/27	1422.7	1972.8	4.5	29.4	0.8520	26.318	Part.; organics
RAC-5	1/27	1053.8	1536.0	9.4	28.0	0.7917	24.630	Part.; SO_2/SO_3

[*] Q_s - Stack flow rate at dry standard conditions.

[†] Q_a - Stack flow rate at actual stack conditions.

[‡] E.A. - Calculated excess air.

[§] V_{mstd} - Volume of flue gas sampled at dry standard conditions.

TABLE 9. TOTAL >C_6 ORGANIC EMISSIONS ($\mu g/m^3$)

	SASS No.1	SASS No. 2	Tenax RAC No. 2	Tenax RAC No. 4	Particulate RAC Nos. 1-5
TCO*	221	307	290	1,070	360
Gravimetric	565	21,725	5,050	17,200	2,540
Total	786	22,032	5,340	18,270	2,900

*Total Chromatographable Organics (C_7-C_{16} B.P. Equivalents).

TABLE 12. ORGANIC EMISSIONS IN CAFB RAC SAMPLES ($\mu g/m^3$)

IAE*	Tenax: RAC-2	Tenax: RAC-4	Particulate: RAC 1-5
7	-	5.53	-
8	-	-	28.8
9	41.8	230	324
10	115	731	-
11	-	13.4	7.17
12	32.4	17.4	-
13	8.53	-	-
14	12.7	-	-
15	82.7	60.7	-
16	-	10.5	-
TCO	290	1070	360
Grav.	5050	17200	2540
TO	5340	18300	2900

*Individual alkane equivalents.

TABLE 15. INTERPRETATION OF IR SPECTRA FROM GRAVIMETRIC RESIDUES OF RAC SAMPLE EXTRACTS WITHOUT LC FRACTIONS

Sample code	Major	Medium	Minor	Trace
RAC-2, Tenax	Amides* (primary, secondary)	Ethers,* hydrocarbons;* possible: amines,* alcohols/phenols	Possible: organosilicon compounds	Possible: esters,* ketones*
RAC-4, Tenax	Hydrocarbons,* esters,* ketones;* possible: alcohols/phenols, amines,* amides		Possible: ethers*	
RAC 1-5, Particulate		Esters,* ketones* saturated hydrocarbons; possible: ethers,* organosilicon compounds, substituted aromatics		

*May be saturated, unsaturated, aryl.

TABLE 18. INTERPRETATION OF IR SPECTRA FROM GRAVIMETRIC RESIDUES OF TENAX RESIN EXTRACT AND ITS LC FRACTIONS, RAC RUN No. 4

Sample code	Major	Medium	Minor	Trace	Weight distribution (percent)
RAC, Tenax	Hydrocarbons,[*] esters,[*] ketones;[*] possible: alcohols/phenols,[‡] amines,[*],[‡] amides,[*] ethers[*]				100[†]
LC-1		Saturated hydrocarbons	Aromatic hydrocarbons	Aryl or vinyl ethers	8.8
LC-2		Saturated hydrocarbons		Unsaturated hydrocarbons	0.2
LC-3		Substituted aromatics, esters;[*] possible: amines,[*] amides,[*] ethers,[*] unsaturated alcohols	Possible: nitro-substituted compounds, phenols		11.4
LC-4		Esters;[*] possible: amides,[*] amines,[*] ethers[*]	Possible: unsaturated alcohols, nitrosubstituted compounds		21.6
LC-5		Esters,[*] ketones;[*] possible: amides,[*],[‡] amines,[*],[†] ethers,[*],[†] alcohols/phenols[†]			36.6
LC-6		Esters,[*] ketones;[*] possible: amides,[*],[†] amines,[*],[†] ethers,[*],[†] alcohols/phenols[†]			18.3
LC-7			Ketones,[*] esters;[*] possible: ethers,[*] phenols, amines,[*],[‡]		3.0

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[*] May be saturated, unsaturated, and/or aryl.

[†] Column percent recovery: 114 percent.

[‡] May possess an isopropyl group attached to N or O.

TABLE 24. RAC-1 TRACE ELEMENT EMISSIONS

ELEMENT	CYCLONE CATCH (MG)	FILTER CATCH (MG)	TOTAL RAC (MG)	EMISSION FOUND (MG/DSCM)
U	0.0032	< 0.0088	0.0032 TO 0.0088	0.0038 TO 0.011
TH	0.0063	< 0.018	0.0063 TO 0.018	0.0075 TO 0.021
BI	0.0005	< 0.0053	0.0005 TO 0.0053	0.0006 TO 0.0063
PB	0.017	0.040	0.056	0.067
TL	0.0065	< 0.0003	0.0065	0.0078
AU	< 0.0002	< 0.0003	< 0.0005	< 0.0006
IR	< 0.0003	< 0.0005	< 0.0008	< 0.0009
OS	< 0.0003	< 0.0006	< 0.0008	< 0.0010
RE	0.0005	< 0.0029	0.0005 TO 0.0029	0.0006 TO 0.0035
W	0.0002	< 0.0028	0.0002 TO 0.0028	0.0003 TO 0.0033
HF	< 0.0030	< 0.0060	< 0.0090	< 0.011
LU	< 0.0008	< 0.0034	< 0.0042	< 0.0050
YB	< 0.0013	< 0.0017	< 0.0029	< 0.0035
TM	< 0.0005	< 0.0007	< 0.0012	< 0.0014
ER	< 0.0013	< 0.0030	< 0.0042	< 0.0051
HO	< 0.0001	< 0.0010	< 0.0011	< 0.0013
DY	< 0.0009	< 0.0078	< 0.0087	< 0.0100
TB	< 0.0002	< 0.0001	< 0.0003	< 0.0003
GD	< 0.0006	< 0.0020	< 0.0026	< 0.0031
EU	< 0.0006	< 0.0036	< 0.0043	< 0.0051
SM	0.0013	0.0036	0.0049	0.0058
ND	0.0028	0.012	0.014	0.017
PR	0.0009	0.0051	0.0060	0.0071
CE	0.0095	0.027	0.036	0.043
LA	0.013	0.038	0.051	0.061
BA	0.19	0.71	0.89	1.1
CS	0.0003	0.0012	0.0015	0.0018
I	0.0016	< 0.0011	0.0016	0.0019
TE	< 0.0013	< 0.0025	< 0.0038	< 0.0046
SB	0.0007	0.0015	0.0022	0.0027
SN	0.0012	0.0068	0.0080	0.0095
CD	0.0002	0.0008	0.0011	0.0013
PD	< 0.0014	< 0.0019	< 0.0034	< 0.0040
RH	< 0.0002	< 0.0001	< 0.0003	< 0.0003
RU	< 0.0001	< 0.0003	< 0.0004	< 0.0005
MO	0.0009	0.0018	0.0027	0.0032
NB	0.0057	0.016	0.022	0.026
ZR	0.065	0.22	0.29	0.34
Y	0.012	0.016	0.028	0.033
SR	0.44	0.61	1.0	1.2
RB	0.0057	0.016	0.022	0.026
BR	0.012	< 0.0093	0.012	0.015
SE	0.0044	< 0.0086	0.0044	0.0052
AS	0.014	0.0070	0.021	0.025
GE	< 0.0075	< 0.0077	< 0.015	< 0.018
GA	0.012	< 0.068	0.012 TO 0.068	0.015 TO 0.081
ZN	0.56	0.093	0.66	0.78
CU	0.020	0.040	0.061	0.072
NI	0.79	0.035	0.82	0.98
CO	0.0044	0.0043	0.0087	0.0100
FE	25.	15.	40.	48.
MN	0.53	0.18	0.71	0.84
CR	0.018	0.015	0.033	0.039
V	0.044	0.086	0.13	0.15
TI	1.6	11.	12.	15.
CA	33.	110.	140.	170.
K	1.3	4.3	5.6	6.6
S	29.	8.1	37.	44.
P	0.033	0.20	0.23	0.27
SI	15.	90.	100.	120.
AL	2.3	MC	-	-
MG	1.2	4.2	5.4	6.4
NA	0.100	1.2	1.3	1.5
B	0.15	0.96	1.1	1.3
BE	0.0004	0.0007	0.0011	0.0013
LI	0.0060	0.0065	0.013	0.015

MC INDICATES A MAJOR COMPONENT OF THE SAMPLE.

- INDICATES THAT THE TOTAL AND EMISSION VALUES WERE NOT CALCULATED OWING TO THE PRESENCE OF AN MC CONCENTRATION.

TABLE 25. RAC-2 TRACE ELEMENT EMISSIONS

ELEMENT	CYCLONE CATCH (MG)	FILTER CATCH (MG)	TOTAL RAC (MG)	EMISSION FOUND (MG/DSCM)
U	0.0026	0.0050	0.0076	0.0079
TH	0.0038	0.015	0.018	0.019
BI	0.0005	0.0046	0.0050	0.0052
PB	0.049	0.083	0.13	0.14
TL	< 0.0006	< 0.0033	< 0.0039	< 0.0041
AU	< 0.0001	< 0.0005	< 0.0006	< 0.0006
IR	< 0.0002	< 0.0007	< 0.0009	< 0.0009
OS	< 0.0002	< 0.0008	< 0.0010	< 0.0010
RE	0.0003	< 0.0040	0.0003 TO 0.0040	0.0003 TO 0.0042
W	0.0004	0.0018	0.0022	0.0023
HF	< 0.0003	< 0.0008	< 0.0011	< 0.0011
LU	< 0.0001	< 0.0005	< 0.0007	< 0.0007
YB	< 0.0006	< 0.0030	< 0.0036	< 0.0038
TM	< 0.0001	< 0.0014	< 0.0015	< 0.0016
ER	< 0.0007	< 0.0051	< 0.0057	< 0.0060
HO	< 0.0003	< 0.0027	< 0.0030	< 0.0031
DY	< 0.0006	< 0.0011	< 0.0018	< 0.0018
TB	0.0001	< 0.0026	0.0001 TO 0.0026	0.0001 TO 0.0027
GD	< 0.0004	< 0.0028	< 0.0032	< 0.0034
EU	0.0002	0.0008	0.0010	0.0010
SM	0.0009	0.0048	0.0057	0.0059
ND	0.0035	0.034	0.037	0.039
PR	0.0010	0.0069	0.0079	0.0082
CE	0.014	0.051	0.065	0.068
LA	0.0069	0.040	0.047	0.049
BA	0.24	1.5	1.8	1.8
CS	0.0004	0.0016	0.0021	0.0021
I	0.0020	0.0025	0.0044	0.0046
TE	< 0.0005	< 0.0045	< 0.0049	< 0.0051
SB	0.0011	0.011	0.012	0.013
SN	0.0014	0.016	0.017	0.018
CD	0.0008	0.0099	0.011	0.011
PD	< 0.0001	< 0.0020	< 0.0021	< 0.0022
RH	< 0.0001	< 0.0002	< 0.0003	< 0.0003
RU	< 0.0001	< 0.0004	< 0.0006	< 0.0006
MO	0.0008	0.0087	0.0095	0.0099
NB	0.0031	0.0092	0.012	0.013
ZR	0.036	0.14	0.17	0.18
Y	< 0.0001	0.020	0.020	0.021
SR	0.19	2.0	2.2	2.2
RB	0.0036	0.024	0.028	0.029
BR	0.0079	0.0100	0.018	0.019
SE	0.0041	0.018	0.022	0.023
AS	0.0070	0.047	0.054	0.057
GE	0.011	0.013	0.024	0.025
GA	0.0092	0.12	0.13	0.14
ZN	0.36	0.16	0.52	0.54
CU	0.031	0.16	0.20	0.20
NI	0.0051	0.012	0.017	0.018
CO	0.0021	0.0083	0.0100	0.011
FE	9.0	12.	21.	21.
MN	0.20	0.41	0.61	0.63
CR	0.0059	0.062	0.068	0.071
V	0.041	0.20	0.24	0.25
TI	0.45	7.9	8.3	8.7
CA	33.	110.	140.	150.
K	0.36	3.2	3.6	3.7
S	47.	11.	58.	60.
P	0.042	0.49	0.53	0.55
SI	6.9	67.	74.	77.
AL	1.1	12.	13.	14.
MG	0.54	28.	28.	29.
NA	0.13	0.84	0.97	1.0
B	0.046	0.37	0.42	0.43
BE	0.0002	0.0012	0.0014	0.0015
LI	0.0024	0.027	0.029	0.031

TABLE 28. QUANTIFICATION DATA FROM ESCA ANALYSES OF RAC TRAIN PARTICULATE FILTERS (RESULTS IN PERCENT ATOMIC)

Element	RAC-1	RAC-2	RAC-3	RAC-4	RAC-5
O	55.5	49.1	54.6	51.9	51.4
C	19.3	24.1	23.4	23.9	27.4
Ca	5.3	4.8	4.2	3.5	5.0
Na	-	1.3	-	-	-
S	4.1	3.9	4.9	3.5	3.2
Si	6.8	5.9	5.4	7.9	6.6
Al	9.0	10.9	7.5	9.3	6.3

TABLE 29. ELEMENTAL QUANTIFICATION DATA FOR SASS PARTICULATE SAMPLES FROM ESCA ANALYSIS; RESULTS IN PERCENT ATOMIC

	SASS run No. 1				SASS run No. 2			
Element	Particulate filter	1μ cyclone	3μ cyclone	10μ cyclone	Particulate filter	1μ cyclone	3μ cyclone	10μ cyclone
O	43.1	44.5	47.3	48.6	33.0	*	55.0	53.9
C	26.9	28.9	29.4	30.0	52.3	*	25.8	24.4
Ca	12.8	9.2	4.3	3.3	2.8	*	3.3	4.8
Na	0.6	0.7	0.8	0.6	1.0	*	0.8	-
S	4.7	6.9	6.1	7.7	3.7	*	6.3	10.5
Si	5.7	4.8	6.1	4.4	2.5	*	4.2	2.4
Al	6.3	5.0	6.0	5.4	4.6	*	4.7	4.0

*Calculations were not made due to high background in spectrum attributed to substrate.

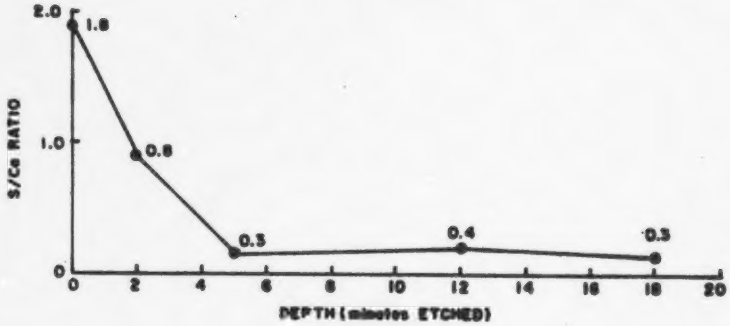

Figure 18. Depth profile of sulfur in SASS-1 filter particulate.

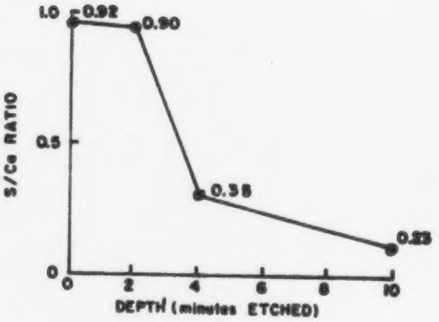

Figure 19. Depth profile of sulfur in SASS-2 filter particulate.

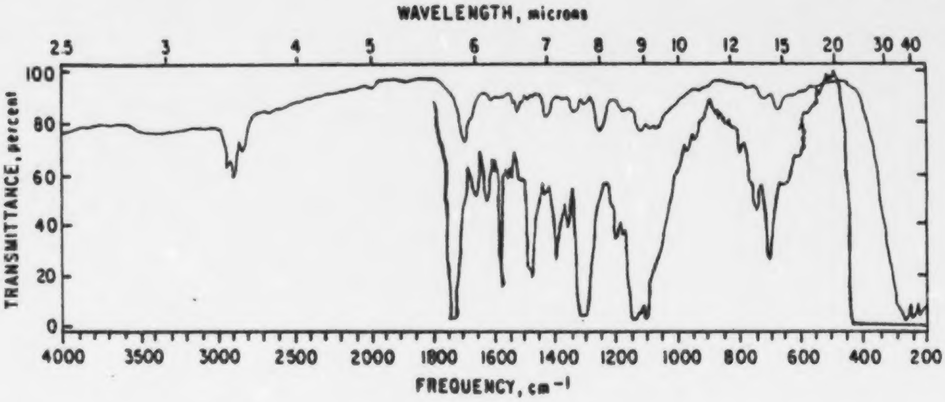

Figure 7. IR spectrum of XAD-2 resin from SASS-1. Major peaks indicate esters, saturated hydrocarbons; possible ethers and nitrosubstituted compounds.

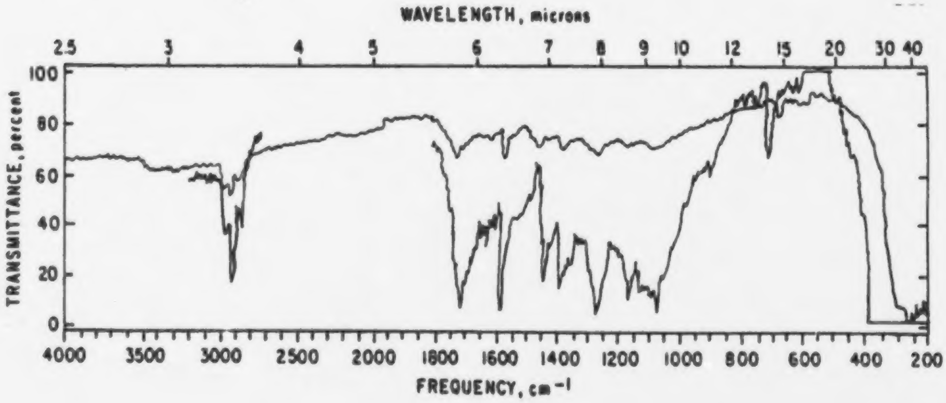

Figure 8. IR spectrum of XAD-2 resin from SASS-2. Major peaks indicate aryl or unsaturated esters, ketones, hydrocarbons; possible ethers and nitrocompounds.

TABLE 30. SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT

SAM/IA WORKSHEET FOR LEVEL 1 **Form IA02 Level 1**

1. SOURCE/CONTROL OPTION Page 1

ESSO, England, CAFB Pilot Plant

2. EFFLUENT STREAM

101 (CODE #) Flue Gas (NAME)

3. EFFLUENT STREAM FLOW RATE

Q = 0.6 m^3/sec

(gas = m^3/sec — liquid = l/sec — solid waste = g/sec)

4. COMPLETE THE FOLLOWING TABLE FOR THE EFFLUENT STREAM OF LINE 2 (USE BACK OF FORM FOR SCRATCH WORK)

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS	µg/m^3	µg/m^3	µg/m^3	—	—	—	—	—	—		
C_1	9.0E3	3.3E5	1.0	0.03	-	9,000	2		✓	0.02	5,355
C_2	2.0E3	5.3E6	1.1E5	0.0004	-	0.02	2			0.0002	0.01
NO	2.8E4	9.0E3	N	3.1				✓		1.84	
NO_x	3.7E4	9.0E3	N	4.1				✓		2.44	
SO_2	5.1E5	1.3E4	N	39.2				✓		23.52	
SO_3	3.2E3	N	N								
CO	<5.7E5	4.0E4	1.2E5	<14.3		4.75		✓	✓	8.51	2.83
CO_2	1.4E8	9.0E6	N	15.6				✓		9.28	

IF MORE SPACE IS NEEDED, USE A CONTINUATION SHEET

5. EFFLUENT STREAM DEGREE OF HAZARD

HEALTH MATE BASED (Σ COL. E) 5a 76.3

ECOLOGICAL MATE BASED (Σ COL. G) 5b 9,005

(ENTER HERE AND AT LINE 8, FORM IA01)

6. NUMBER OF ENTRIES COMPARED TO MATES

HEALTH 6a 7

ECOLOGICAL 6b 3

7. TOXIC UNIT DISCHARGE SUM

HEALTH MATE BASED (Σ COL. K) 7a 45.6

ECOLOGICAL MATE BASED (Σ COL. L) 7b 5,358

(ENTER HERE AND AT LINE 8, FORM IA01)

TABLE 31. SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT, SASS-1

SAM/IA WORKSHEET FOR LEVEL 1

Form IA02 Level 1

1. SOURCE/CONTROL OPTION

Page 1 /

ESSO, England, CAFB Pilot Plant, SASS-1

2. EFFLUENT STREAM

101 — CODE #

Flue gas — NAME

3. EFFLUENT STREAM FLOW RATE

Q = 0.52 m³/sec

(gas = m³/sec — liquid = l/sec — solid waste = g/sec)

4. COMPLETE THE FOLLOWING TABLE FOR THE EFFLUENT STREAM OF LINE 2 (USE BACK OF FORM FOR SCRATCH WORK)

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS	μg/m³			—	—	—	—	—	—		
U	18										
Th	46										
Bi	0.6-35	4.1E2	N	.001-.085						.0005-.04	
Pb	200										
Tl	< 2.1	1.5E2	N	<0.014						<0.01	
Au	< 2.1	N	N								
Ir	< 3.2										
Os	< 3.5										
Re	< 2.2										
W	< 6.1	1.0E3	N	<0.006						<0.003	
Hf	<24										
Lu	< 6.2										
Yb	< 5.9										
Tm	< 1.1										

IF MORE SPACE IS NEEDED, USE A CONTINUATION SHEET

5. EFFLUENT STREAM DEGREE OF HAZARD

HEALTH MATE BASED (Σ COL E) 5a ~513

ECOLOGICAL MATE BASED (Σ COL G) 5b 310

(ENTER HERE AND AT LINE 8, FORM IA01)

6. NUMBER OF ENTRIES COMPARED TO MATES

HEALTH 6a 31

ECOLOGICAL 6b 1

7. TOXIC UNIT DISCHARGE SUM

HEALTH MATE BASED (Σ COL. K) 7a ~267

ECOLOGICAL MATE BASED (Σ COL. L) 7b 161

(ENTER HERE AND AT LINE 8, FORM IA01)

TABLE 31 (continued). SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT, SASS-1

CONTINUATION SHEET FOR ITEM NO. 4. FORM IA02. LEVEL 1 Page /

SOURCE/CONTROL OPTION ESSO, England, CAFB Pilot Plant, SASS-1 EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS	μg/m³			—	—	—	—	—	—		
Er	< 6.9										
Ho	<0.1-2.3										
Dy	0.2-9.4	9.3E3	N	<0.001						<0.0005	
Tb	< 0.3										
Gd	< 4.6										
Eu	0.6-3.4										
Sm	3.3-16.0	5.3E4	N	<0.0003						<0.00002	
Nd	31	N	N								
Pr	10	5.1E4	N	0.0002						0.0001	
Ce	98	3.7E4	N	0.0026						0.0014	
La	200	1.1E5	N	0.0018						0.0009	
Ba	2,800	5.0E2	N	5.6				✓		2.91	
Cs	3.7										
I	1.3										
Te	8.8	1.0E2	N	0.088						0.046	
Sb	7.2	5.0E2	N	0.014						0.007	
Sn	71	N	N								
Cd	5.4	1.0E1	N	0.54						0.281	
Pd	7.9										
Rh	0.9										
Ru	< 1.9										
Mo	8.4	5.0E3	N	0.002						0.001	
Nb	81										
Zr	510										
Y	120										

TABLE 31 (continued). SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT, SASS-1

CONTINUATION SHEET FOR ITEM NO. 4, FORM IA02, LEVEL 1

Page

SOURCE/CONTROL OPTION ESSO, England, CAFB Pilot Plant, SASS-1 EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCEN TRATION	HEALTH MATE CONCEN TRATION	ECOLOGICAL MATE CONCEN TRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E x LINE 3)	(ECOLOGICAL BASED) (G x LINE 3)
UNITS	$\mu g/m^3$			—	—	—	—	—	—		
Sr	2,600	3.1E3	N	0.839						0.436	
Rb	50										
Br	160										
Se	0.6-75	2.0E2	N	.003-.375						<0.195	
As	650	2.0	N	325				✓		169	
Ge	6.2-33	5.6E2	N	.011-.059						<0.031	
Ga	170	5.0E3	N	0.034						0.018	
Zn	860	4.0E3	N	0.215						0.112	
Cu	180	2.0E2	N	0.90						0.468	
Ni	230	1.5E1	N	15.33				✓		7.97	
Co	48	5.0E1	N	0.96						0.50	
Fe	-										
Mn	1,700	5.0E3	N	0.34						0.177	
Cr	110	1	N	110				✓		57.2	
V	310	5.0E2	1	0.62		310			✓	0.322	161
Ti	13,000	6.0E3	N	2.17				✓		1.128	
Ca	210,000										
K	11,000	N	N								
S	-										
P	1,600	1.0E2	N	16				✓		8.32	
Si	230,000	1.0E4	N	23				✓		11.96	
Al	-	5.2E3	N								
Mg	16,000	6.0E3	N	2.67				✓		1.388	
Na	-	5.3E4	N								
B	4,300	3.1E3	N	1.387				✓		0.721	
Be	14	2.0	N	7				✓		3.64	

TABLE 32. SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT, SASS-2

SAM/IA WORKSHEET FOR LEVEL 1

Form IA02 Level 1

1. SOURCE/CONTROL OPTION

Page 1

ESSO, England, CAFB Pilot Plant, SASS-2

2. EFFLUENT STREAM

101 (CODE #) Flue gas (NAME)

3. EFFLUENT STREAM FLOW RATE

Q = 0.60 m^3/sec

(gas = m^3/sec — liquid = l/sec — solid waste = g/sec)

4. COMPLETE THE FOLLOWING TABLE FOR THE EFFLUENT STREAM OF LINE 2 (USE BACK OF FORM FOR SCRATCH WORK)

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ if HEALTH MATE EXCEEDED	√ if ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS	ug/m^3			—	—	—	—	—	—		
U	13										
Th	35										
Bi	0.5-28	4.1E2	N	.001-.068						<0.041	
Pb	310										
Tl	< 13	1.5E2	N	<0.087						<0.052	
Au	< 13	N	N								
Ir	< 20										
Os	< 22										
Re	< 14										
W	< 23	1.0E3	N	<0.023						<0.014	
Hf	< 49										
Lu	< 13										
Yb	< 12										
Tm	< 5.8										

IF MORE SPACE IS NEEDED, USE A CONTINUATION SHEET

5. EFFLUENT STREAM DEGREE OF HAZARD
HEALTH MATE BASED (Σ COL. E) 5a ~920
ECOLOGICAL MATE BASED (Σ COL. G) 5b 430
(ENTER HERE AND AT LINE 8, FORM IA01)

6. NUMBER OF ENTRIES COMPARED TO MATES
HEALTH 6a 31
ECOLOGICAL 6b 1

7. TOXIC UNIT DISCHARGE SUM
HEALTH MATE BASED (Σ COL. K) 7a ~551
ECOLOGICAL MATE BASED (Σ COL. L) 7b 258
(ENTER HERE AND AT LINE 8, FORM IA01)

TABLE 32 (continued). SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT, SASS-2

CONTINUATION SHEET FOR ITEM NO. 4. FORM IA02. LEVEL 1

Page

SOURCE/CONTROL OPTION ESSO, England, CAFB Pilot Plant, SASS-2 EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	✓ IF HEALTH MATE EXCEEDED	✓ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E x LINE 3)	(ECOLOGICAL BASED) (G x LINE 3)
UNITS	$\mu g/m^3$			—	—	—	—	—	—		
Er	< 18										
Ho	< 6.2										
Dy	< 19	9.3E3	N	<0.002						<0.0012	
Tb	< 2.2										
Gd	< 14										
Eu	<0.1-8.1										
Sm	1.1-31	5.3E4	N	<0.001						<0.0006	
Nd	17-44	N	N								
Pr	11	5.1E4	N	0.0002						0.00012	
Ce	97	3.7E4	N	0.003						0.00018	
La	200	1.1E5	N	0.002						0.00012	
Ba	5,100	5.0E2	N	10.2				✓		6.12	
Cs	3.5										
I	2.7-12										
Te	0.1-15	1.0E2	N	.001-.15						<0.09	
Sb	18	5.0E2	N	0.036						0.022	
Sn	18-400	N	N								
Cd	2.0-27	1.0E1	N	0.2-2.7				✓		<1.62	
Pd	< 16										
Rh	< 3.9										
Ru	< 13										
Mo	12	5.0E3	N	0.002						0.0012	
Nb	78										
Zr	540										
Y	87										
Sr	5,000	3.1E3	N	1.613				✓		0.968	

TABLE 32 (continued). SAM/IA WORKSHEET FOR LEVEL I - ESSO, ENGLAND, CAFB PILOT PLANT, SASS-2

CONTINUATION SHEET FOR ITEM NO. 4. FORM IA02. LEVEL 1

Page

SOURCE/CONTROL OPTION ESSO, England, CAFB Pilot Plant, SASS-2 EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCEN-TRATION	HEALTH MATE CONCEN TRATION	ECOLOGICAL MATE CONCEN TRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E x LINE 3)	(ECOLOGICAL BASED) (G x LINE 3)
UNITS	μg/m³			—	—	—	—	—	—		
Rb	63										
Br	190										
Se	14-160	2.0E2	N	.07-0.80						<0.48	
As	1,000	2.0	N	500				✓		300	
Ge	41	5.6E2	N								
Ga	260	5.0E3	N	0.052						0.031	
Zn	1,900	4.0E3	N	0.475						0.285	
Cu	260	2.0E2	N	1.30				✓		0.78	
Ni	130-630	1.5E1	N	8.67-42				✓		<25.2	
Co	44	5.0E1	N	0.88						0.528	
Fe	-										
Mn	2,000	5.0E3	N	0.4						0.24	
Cr	330	1	N	330				✓		198	
V	430	5.0E2	1	0.86		430				0.516	258
Ti	14,000	6.0E3	N	2.33				✓		1.398	
Ca	-										
K	7,700	N	N								
S	220,000										
P	1,600	1.0E2	N	16				✓		9.6	
Si	-	1.0E4	N								
Al	-	5.2E3	N								
Mg	15,000	6.0E3	N	2.5				✓		1.5	
Na	5000-14,000	5.3E4	N	.094-.264						<0.158	
B	3,100	3.1E3	N	1				✓		0.6	
Be	3.8	2.0	N	1.9				✓		1.14	
Li	60	2.2E1	N	2.73				✓		1.638	

TABLE 33. SAM/1A WORKSHEET FOR LEVEL I - CONVENTIONAL LIGNITE BOILER WITH MULTICLONE - SITE A

SAM/IA WORKSHEET FOR LEVEL 1

Form IA02 Level 1

1 SOURCE/CONTROL OPTION

Conventional Lignite Boiler With Multiclone - Site A

Page 1 /

2 EFFLUENT STREAM

101 (CODE #) Flue Gas (NAME)

3 EFFLUENT STREAM FLOW RATE

Q = 27.9 m^3/sec

(gas = m³/sec — liquid = l/sec — solid waste = g/sec)

4. COMPLETE THE FOLLOWING TABLE FOR THE EFFLUENT STREAM OF LINE 2 (USE BACK OF FORM FOR SCRATCH WORK)

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS	ug/m^3	ug/m^3		—	—	—	—	—	—		
U	56										
Th	74										
Bi	2.6	4.1E2	N	0.006						.167	
Pb	320										
Tl	< 8.3	1.5E2	N	<.055						<1.535	
Au	< 4.1	N	N								
Ir	< 6.3										
Os	< 7.0										
Re	< 4.5										
W	6.2-33	1.0E3	N	.006-.033						< .921	
Hf	<13										
Lv	< 3										
Yb	< 3.2										
Tm	< 2.5										

IF MORE SPACE IS NEEDED, USE A CONTINUATION SHEET

5. EFFLUENT STREAM DEGREE OF HAZARD
HEALTH MATE BASED (Σ COL. E) 5a < 2032
ECOLOGICAL MATE BASED (Σ COL. G) 5b 470
(ENTER HERE AND AT LINE 8, FORM IA01)

6. NUMBER OF ENTRIES COMPARED TO MATES
HEALTH 6a 30
ECOLOGICAL 6b 1

7. TOXIC UNIT DISCHARGE SUM
HEALTH MATE BASED (Σ COL. K) 7a < 56,700
ECOLOGICAL MATE BASED (Σ COL. L) 7b 13,113
(ENTER HERE AND AT LINE 8, FORM IA01)

TABLE 33 (continued). SAM/1A WORKSHEET FOR LEVEL I - CONVENTIONAL LIGNITE BOILER WITH MULTICLONE - SITE A

CONTINUATION SHEET FOR ITEM NO. 4, FORM 1A02, LEVEL 1

Page 2

SOURCE/CONTROL OPTION Conventional Lignite Boiler With Multiclone

EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
SAMPLE FRACTION	FRACTION CONCEN-TRATION	HEALTH MATE CONCEN-TRATION	ECOLOGICAL MATE CONCEN-TRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	TOXIC UNIT DISCHARGE RATE (HEALTH BASED) (E × LINE 3)	TOXIC UNIT DISCHARGE RATE (ECOLOGICAL BASED) (G × LINE 3)
UNITS	$\mu g/m^3$	$\mu g/m^3$		—	—	—	—	—	—		
Er	< 4.8										
Ho	< 1.1										
Dy	< 3.2	9.3E3	N	.0003							
Tb	< 0.7									< .008	
Gd	< 3.2										
Eu	< 1.8										
Sm	< 5.4	5.3E4	N	<.0001							
Nd	13	N	N							< .003	
Pr	29	5.1E4	N	.0006							
Ce	240	3.7E4	N	.0065						.017	
La	320	1.1E5	N	.0029						.181	
Ba	200,000	5.0E2	N	400						.081	
Cs	18									11,160	
I	3.3										
Te	< 3.3	1.0E2	N	<.033							
Sb	40	5.0E2	N	.08						< .921	
Sn	23	N	N							2.232	
Cd	33	1.0E1	N	3.3							
Pd	< 6.7									92.07	
Rh	6.6										
Ru	< 3.6										
Mo	38	5.0E3	N	.0076							
Nb	67									0.212	
Zr	1300										
Y	190										
Sr	41,000	3.1E3	N	13.23					✓		369.1	

TABLE 33 (continued). SAM/1A WORKSHEET FOR LEVEL I - CONVENTIONAL LIGNITE BOILER WITH MULTICLONE - SITE A

CONTINUATION SHEET FOR ITEM NO. 4. FORM IA02. LEVEL 1 Page 3

SOURCE CONTROL OPTION Conventional Lignite Boiler With Multiclone EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E x LINE 3)	(ECOLOGICAL BASED) (G x LINE 3)
UNITS				—	—	—	—	—	—		
Rb	290										
Br	210										
Se	83	2.0E2	N	.415				✓		11.58	
As	1,600	2.0	N	800						22,320	
Ge	7.2	5.6E2	N	.0129						.360	
Ga	240	5.0E3	N	.048						1.34	
Zn	880	4.0E3	N	.220						6.138	
Cu	470	2.0E2	N	2.35				✓		65.57	
Ni	1,400	1.5E1	N	93.33				✓		2604	
Co	100	5.0E1	N	2.0				✓		55.8	
Fe	---										
Mn	27,000	5.0E3	N	5.4				✓		150.7	
Cr	470	1	N	470				✓		13,113	
V	470	5.0E2	1	.94		470				26.23	13,113
Ti	28,000	6.0E3	N	4.67				✓		130.3	
Ca	---										
K	39,000	N	N								
S	160,000										
P	16,000	1.0E2	N	160				✓		4,464	
Si	---	1.0E4	N								
Al	---	5.2E3	N								
Mg	---	6.0E3	N								
Na	---	5.3E4	N								
B	140,000	3.1E3	N	45.16				✓		1,260	
Be	10	2.0	N	5.0				✓		139.5	
Li	570	2.2E1	N	25.91				✓		722.9	

TABLE 34. SAM/1A WORKSHEET FOR LEVEL I - CONVENTIONAL LIGNITE BOILER WITH ESP - SITE B

SAM/IA WORKSHEET FOR LEVEL 1

Form IA02 Level 1

1. SOURCE/CONTROL OPTION

Conventional Lignite Boiler With ESP - Site B

Page 1

2. EFFLUENT STREAM

101 (CODE #) Flue Gas (NAME)

3. EFFLUENT STREAM FLOW RATE

Q = 40.5 m^3/sec

(gas = m³/sec — liquid = l/sec — solid waste = g/sec)

4. COMPLETE THE FOLLOWING TABLE FOR THE EFFLUENT STREAM OF LINE 2 (USE BACK OF FORM FOR SCRATCH WORK)

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS				—	—	—	—	—	—		
U	< 1.2										
Th	< 1.7										
Bi	< .5	4.1E2	N	< .0012							
Pb	1.1 - 8.5									<.049	
Tl	< .7	1.5E2	N	<.0047							
Au	< .9	N	N							<.190	
Ir	< 1.4										
Os	< 1.5										
Re	< .9										
W	< 1.3	1.0E3	N	<.0013							
Hf	< 1.6									<.053	
Lv	< .4										
Yb	< .5										
Tm	< .3										

IF MORE SPACE IS NEEDED, USE A CONTINUATION SHEET

5. EFFLUENT STREAM DEGREE OF HAZARD

HEALTH MATE BASED (Σ COL E) 5a < 12.1

ECOLOGICAL MATE BASED (Σ COL G) 5b < 1.1

(ENTER HERE AND AT LINE 8, FORM IA01)

6. NUMBER OF ENTRIES COMPARED TO MATES

HEALTH 6a 34

ECOLOGICAL 6b 1

7. TOXIC UNIT DISCHARGE SUM

HEALTH MATE BASED (Σ COL K) 7a < 490.8

ECOLOGICAL MATE BASED (Σ COL L) 7b < 44.55

(ENTER HERE AND AT LINE 8, FORM IA01)

TABLE 34 (continued). SAM/1A WORKSHEET FOR LEVEL I - CONVENTIONAL LIGNITE BOILER WITH ESP - SITE B

CONTINUATION SHEET FOR ITEM NO. 4. FORM IA02. LEVEL 1 **Page** 2

SOURCE/CONTROL OPTION Conventional Lignite Boiler With ESP EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	TOXIC UNIT DISCHARGE RATE (HEALTH BASED) (E x LINE 3)	(ECOLOGICAL BASED) (G x LINE 3)
UNITS				—	—	—	—	—	—		
Er	< 1										
Ho	< .3										
Dy	< .5	9.3E3	N	.00005						.002	
Tr	< .1										
Gd	< .5										
Ev	< .2										
Sm	< .9	5.3E4	N	.00002						.001	
Nd	< 1.2	N	N								
Pr	< .2	5.1E4	N	<.00001						< .0004	
Ce	< .3	3.7E4	N	<.00001						< .0004	
La	< .3	1.1E5	N	<.00001						< .0004	
Ba	< 28	5.0E2	N	.056						<2.268	
Cs	< .1										
I	< .8										
Te	< .7	1.0E2	N	<.007						< .284	
Sb	< .5	5.0E2	N	<.001						< .041	
Sn	1.3-16	N	N								
Cd	.9-2.1	1.0E1	N	.09-.21						<8.505	
Pd	< .7										
Rh	< .2										
Ru	< .9										
Mo	.8	5.0E3	N	.0002						.008	
Nb	< .1										
Zr	.3										
Y	< .1-.1										
Sr	<10	3.1E3	N	<.0032						< .130	

TABLE 34 (continued). SAM/1A WORKSHEET FOR LEVEL I - CONVENTIONAL LIGNITE BOILER WITH ESP - SITE B

CONTINUATION SHEET FOR ITEM NO. 4, FORM IA02, LEVEL 1

Page 3

SOURCE/CONTROL OPTION Conventional Lignite Boiler With ESP

EFFLUENT STREAM NO 101

A	B	C	D	E	F	G	H	I	J	K	L
										TOXIC UNIT DISCHARGE RATE	
SAMPLE FRACTION	FRACTION CONCENTRATION	HEALTH MATE CONCENTRATION	ECOLOGICAL MATE CONCENTRATION	DEGREE OF HAZARD (HEALTH) (B/C)	ORDINAL POSITION IN HEALTH MATE TABLE	DEGREE OF HAZARD (ECOLOGICAL) (B/D)	ORDINAL POSITION IN ECOL MATE TABLE	√ IF HEALTH MATE EXCEEDED	√ IF ECOL MATE EXCEEDED	(HEALTH BASED) (E × LINE 3)	(ECOLOGICAL BASED) (G × LINE 3)
UNITS				—	—	—	—	—	—		
Rb	< .1-.4										
Br	<43										
Se	9.7	2.0E2	N	.0485						1.964	
As	< 4.2	2.0	N	<2.1				✓		< 85.05	
Ge	< .1-.3	5.6E2	N	<.0005						< .02	
Ga	< .1-.1	5.0E3	N	<.00002						< .001	
Zn	13-31	4.0E3	N	<.0078						< .316	
Cu	< 36	2.0E2	N	<.18						< 7.29	
Ni	< 69	1.5E1	N	< 4.6				✓		< 186.6	
Co	< .8	5.0E1	N	<.016						< .648	
Fe	<170										
Mn	< 7.8	5.0E3	N	<.0016						< .065	
Cr	< 4.2	1	N	<4.2				✓		<170.1	
V	< 1.1	5.0E2	1	<.0022		1.1			✓	< .089	< 44.55
Ti	< 3.5	6.0E3	N	<.0006						< .024	
Ca	40-390										
K	560	N	N								
S	1400-7700										
P	< 46	1.0E2	N	<.46						< 18.63	
Si	180	1.0E4	N	.0180						.729	
Al	36-88	5.2E3	N	<.0169						< .684	
Mg	160	6.0E3	N	.0267						1.081	
Na	680	5.3E4	N	.0128						.518	
B	64	3.1E3	N	.0206						.834	
Be	.2	2.0	N	.1						4.05	
Li	< .3	2.2E1	N	.0136						.551	

TABLE 36. TOTAL CAFB ORGANIC EMISSIONS ($\mu g/m^3$)

	SASS No. 1	SASS No. 2	RAC No. 2	RAC No. 4
$C_1 - C_6$	17,770- 23,192	No data	4,337- 10,384	< 6,380
$C_7 - C_{16}$	221	307	650*	1,430*
$> C_{16}$	565	21,725	7,590*	19,740*
Total	18,556- 23,978	> 21,725	12,577- 18,624	21,170- 27,550

*Average RAC 1-5 particulate emissions plus Tenax captured emissions.

The following ESCA spectra were contained in the document:

SASS-1 filter particulate

SASS-2 filter particulate

SASS-2 1μ cyclone particulate
(carbon 1s spectrum)

RAC-1 filter particulate
(carbon 1s spectrum)

RAC-5 filter particulate
(carbon 1s spectrum)

SASS-2 filter particulate
(sulfur 2p spectrum)

SASS-2 filter particulate
(sulfur 2p spectrum, with argon ion etching: after 2 minutes of etching)

SASS-2 filter particulate
(sulfur 2p spectrum, with argon ion etching: after 18 minutes of etching)

SASS-2, gasifier bed sample
(carbon 1s spectrum)

SASS-1 filter particulate
(carbon 1s spectrum)

STUDY NUMBER 3

DATA SOURCE:	**ENVIRONMENTAL ASSESSMENT OF COAL- AND OIL-FIRING IN A CONTROLLED INDUSTRIAL BOILER;** **Volume I. Executive Summary** **Volume II. Comparative Assessment** **Volume III. Comprehensive Assessment and Appendices**
DATA STATUS:	EPA—600/7-78-164a-c, August 1978
AUTHORS:	C. Leavitt, K. Arledge, W. Hamersma, R. Maddalone, R. Beimer, G. Richard, and M. Yamada
CONTRACTOR:	TRW, Inc. One Space Park Redondo Beach, California 90278 Contract No. 68-02-2613
PROJECT OFFICER:	Wade H. Ponder Industrial Environmental Research Laboratory Office of Energy, Minerals, and Industry U.S. Environmental Protection Agency Research Triangle Park, NC 27711

This study was conducted from October 24, 1977, to May 5, 1978, at the Firestone Tire and Rubber Company's 10-MW dual-fuel industrial process steam boiler in Pottstown, Pennsylvania. (The boiler is equipped with a pilot FMC, Inc., flue gas desulfurization [FGD] unit.) The purpose of the study was to compare and characterize gaseous, solid, and liquid waste-streams from coal firing and oil firing of this boiler. Both controlled and uncontrolled emissions were sampled and analyzed. Figure 3-1 (from the final report) shows a flow diagram of the boiler and FGD system.

This effort encompassed the Level 1 and Level 2 protocol. An exception to the protocol was that Level 2 sampling and analysis were performed prior to completion of Level 1 on samples where sample deterioration was anticipated. For coal and oil firing, these areas were sampled: coal and oil, boiler blowdown water, flyash, flue gas, FGD scrubber cake, boiler and scrubber makeup water, and scrubber makeup solids. Table 3-1 (from the report) details the sampling method and analysis method for each sample.

The basic conclusion of the report was that there was not a significant difference between coal and oil fuels for an industrial boiler when several pertinent factors were considered; in this study the comparative impacts of coal and oil were compared for environmental, energy, economic, and societal effects. Quoting from the report, the major conclusions of the study were:

> (1) While the quantity of particulates from oil firing is considerably less than from coal firing, the particles are generally smaller and more difficult to remove, and the concentration of particulates in the treated flue gas from oil firing exceeded that from coal firing. (2) NO_x and CO emissions during coal firing were about triple those during oil firing. (3) Sulfate emissions from the boiler during coal firing were about triple those during oil firing; however, at the outlet of the control equipment, sulfate concentrations were essentially identical. (4) Most trace element emissions (except vanadium, cadmium, lead, cobalt, nickel, and copper) were higher during coal firing. (5) Oil firing produces cadmium burdens in vegetation approaching levels which are injurious to man; coal firing may produce molybdenum levels which are injurious to cattle. (6) The assessment generally supports the national energy plan for increased use of coal by projecting that the environmental insult from controlled coal firing is not significantly different from that from oil firing.

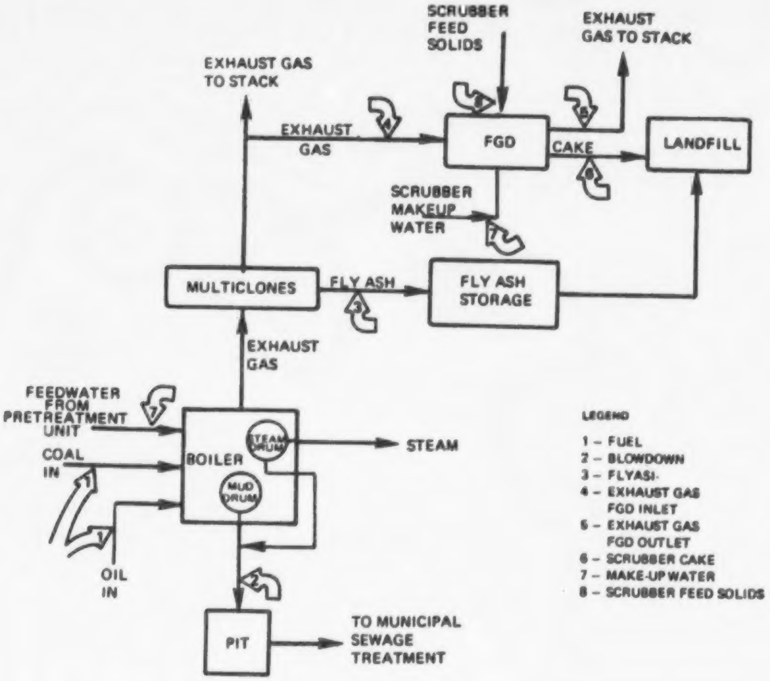
SCRUBBER FEED SOLIDS
EXHAUST GAS TO STACK
EXHAUST GAS TO STACK
EXHAUST GAS
FGD
CAKE
LANDFILL
SCRUBBER MAKEUP WATER
MULTICLONES
FLY ASH
FLY ASH STORAGE
EXHAUST GAS
FEEDWATER FROM PRETREATMENT UNIT
COAL IN
OIL IN
BOILER
STEAM DRUM
MUD DRUM
STEAM
PIT
TO MUNICIPAL SEWAGE TREATMENT
1
2
3
4
5
6
7
7
8
LEGEND
1 – FUEL
2 – BLOWDOWN
3 – FLYASH
4 – EXHAUST GAS FGD INLET
5 – EXHAUST GAS FGD OUTLET
6 – SCRUBBER CAKE
7 – MAKE-UP WATER
8 – SCRUBBER FEED SOLIDS

Figure 3-1. Boiler system schematic and sampling locations.

TABLE 3-1. PARAMETERS SAMPLED FOR COAL AND OIL FIRING

Location	Parameter	Sampling Method	Analysis
1	FUEL (coal & oil)	Grab	
	C, H, N, S, ash, moisture, heating value		Ultimate (lab)
	Inorganics		Level II (lab)
2	COMBINED BLOWDOWN	Composite dipper	On-site HACH kit
	Alkalinity/acidity		
	pH		
	conductivity		
	hardness		
	TSS		
	nitrate		
	sulfate		
	sulfite		
	phosphate		
	ammonia		
	nitrogen		
	organics		Level 1 & 2 (lab)
3	FLYASH	Composite grab	
	inorganics		Level 1 & 2 (lab)
	organics		Level 1 & 2 (lab)
4&5	FLUE GAS (inlet & outlet)		
	CO	Continuous, Beckman Model 865	Direct reading
		Grab (bag)	GC (TCD) on site
	CO_2	Grab (bag)	GC (TCD) on site
	$NO/NO_2/NO_x$	Continuous, TECO Model 10A	Direct reading
	N_2,O_2	Grab (bag)	GC (TCD) on site
	SO_2	Continuous, TECO Model 41	Direct reading
	SO_2/SO_3 H_2SO_4,HCl, HF, particulate sulfate,	Goksoyr-Ross	Level 2 (lab)
	total hydrocarbons (as CH_4)	Continuous, Beckman Model 400	Direct reading
	C_1 - C_6 organics	Grab (bag)	GC (FID) on site
		SASS	Level 1 (lab)
	particulate & vapor	Method 5	Level 2 (lab)
	particulate sizing	Anderson impactor	Level 1
		SASS	Level 2
6	SCRUBBER CAKE	Composite grab	
	inorganics		Level 1 & 2 (lab)
	organics		Level 1 & 2 (lab)
7	BOILER & SCRUBBER MAKEUP WATER	Top grab	
	organics		Level 1 (lab)
	inorganics		Not required
8	SCRUBBER MAKEUP SOLIDS	Grab	Not required

LEVEL 1

TABLE 3-2. SPARK SOURCE MASS SPECTROSCOPY
FUEL OIL, TEST 202-4
(ppm)

U		Dy		Rh		Cr	2.2
Th		Tb		Ru		V	36.5
Bi		Gd		Mo	2.9*	Ti	
Pb	2.6*	Eu		Nb		Sc	
Tl		Sm		Zr	<0.05	Ca	5.50
Hg	0.09†	Nd		Y		K	
Au		Pr		Sr	0.23	Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se	0.7*	Si	
Re		Cs		As	2.0‡	Al	3.5
W		I		Ge		Mg	<0.04
Ta		Te		Ga		Na	
Hf		Sb	0.03*	Zn	3.0	F	
Lu		Sn		Cu	1.40	B	<0.15
Yb		In		Ni	16.0	Be	<0.05§
Tm		Cd	<3.5	Co	<1.25	Li	
Er		Ag		Fe	12.3		
Ho		Pd		Mn	0.4*		

*Values were calculated from concentrations at the scrubber inlet when ICPOES analysis provided upper limit data only.
†Performed by cold-vapor analysis on a feed oil sample from test 203.
‡Arsenic concentration calculated from concentration at the scrubber inlet.
§Performed by SSMS on a feed oil sample from test 203.

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-3. SPARK SOURCE MASS SPECTROSCOPY
FEED COAL, TEST 201-1
(ppm)

U		Dy		Rh		Cr	48
Th		Tb		Ru		V	47
Bi		Gd		Mo	293	Ti	
Pb	85	Eu		Nb		Sc	
Tl		Sm		Zr	270	Ca	770
Hg	0.14*	Nd		Y		K	
Au		Pr		Sr	68	Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se	73	Si	
Re		Cs		As	137	Al	14,000
W		I		Ge		Mg	350
Ta		Te		Ga		Na	
Hf		Sb	85	Zn	56	F	
Lu		Sn		Cu	72	B	2.4†
Yb		In		Ni	37	Be	2.3†
Tm		Cd	3.5	Co	127	Li	
Er		Ag		Fe	12,250		
Ho		Pd		Mn	12		

*Performed by cold-vapor analysis on a fuel coal sample from test 200.
†Performed by SSMS on a feed coal sample from test 200.

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-4. SPARK SOURCE MASS SPECTROSCOPY WASTEWATER INORGANICS, COAL FIRING (μg/L)

U		Dy		Rh		Cr	2
Th		Tb		Ru		V	3
Bi		Gd		Mo		Ti	
Pb	10	Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		ND		Y		K	
Au		Pr		Sr	500	Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb	<1	Zn		F	800
Lu		Sn		Cu	20	B	
Yb		In		Ni	5	Be	<1
Tm		Cd	<1	Co	100	Li	
Er		Ag		Fe			
Ho		Pd		Mn			

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-5. SPARK SOURCE MASS SPECTROSCOPY WASTEWATER INORGANICS, OIL FIRING (μg/L)

U		Dy		Rh		Cr	20
Th		Tb		Ru		V	2
Bi		Gd		Mo		Ti	
Pb	6	Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		ND		Y		K	
Au		Pr		Sr	300	Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb	1	Zn		F	4,000
Lu		Sn		Cu	20	B	
Yb		In		Ni	20	Be	<1
Tm		Cd	<1	Co	7	Li	
Er		Ag		Fe			
Ho		Pd		Mn			

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-6. SPARK SOURCE MASS SPECTROSCOPY SCRUBBER CAKE FROM OIL FIRING (DRY BASIS), TEST 202-4 (μg/g)

U		Dy		Rh		Cr	
Th		Tb		Ru		V	
Bi		Gd		Mo	14*	Ti	
Pb	6*	Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		Nd		Y		K	
Au		Pr		Sr		Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se	9*	Si	
Re		Cs		As	15*	Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb	3*	Zn		F	
Lu		Sn		Cu		B	
Yb		In		Ni		Be	
Tm		Cd	1*	Co	19*	Li	
Er		Ag		Fe			
Ho		Pd		Mn			

*SSMS analyses were utilized where ICPOES analysis provided upper limit data only.

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-7. SPARK SOURCE MASS SPECTROSCOPY SCRUBBER INLET COAL FIRING, TEST 201-1 (mg/m^3)

U		Dy		Rh		Cr	
Th		Tb		Ru		V	
Bi		Gd		Mo		Ti	
Pb		Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		Nd		Y		K	
Au		Pr		Sr		Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb		Zn		F	
Lu		Sn		Cu		B	0.2
Yb		In		Ni		Be	0.1
Tm		Cd		Co		Li	
Er		Ag		Fe			
Ho		Pd		Mn			

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-8. SPARK SOURCE MASS SPECTROSCOPY SCRUBBER OUTLET COAL FIRING, TEST 201-1

(mg/m^3)

U		Dy		Rh		Cr	
Th		Tb		Ru		V	
Bi		Gd		Mo		Ti	
Pb		Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		Nd		Y		K	
Au		Pr		Sr		Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb		Zn		F	
Lu		Sn		Cu		B	0.03
Yb		In		Ni		Be	0.002
Tm		Cd		Co		Li	
Er		Ag		Fe			
Ho		Pd		Mn			

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-9. SPARK SOURCE MASS SPECTROSCOPY SCRUBBER OUTLET COAL FIRING, TEST 202-4 (mg/m^3)

U		Dy		Rh		Cr	
Th		Tb		Ru		V	
Bi		Gd		Mo		Ti	
Pb		Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		Nd		Y		K	
Au		Pr		Sr		Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb		Zn		F	
Lu		Sn		Cu		B	
Yb		In		Ni		Be	0.001
Tm		Cd		Co		Li	
Er		Ag		Fe			
Ho		Pd		Mn			

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-10. SPARK SOURCE MASS SPECTROSCOPY SCRUBBER INLET COAL FIRING, TEST 202-4 (mg/m^3)

U		Dy		Rh		Cr	
Th		Tb		Ru		V	
Bi		Gd		Mo		Ti	
Pb		Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		Nd		Y		K	
Au		Pr		Sr		Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb		Zn		F	
Lu		Sn		Cu		B	
Yb		In		Ni		Be	<0.001
Tm		Cd		Co		Li	
Er		Ag		Fe			
Ho		Pd		Mn			

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-11. SPARK SOURCE MASS SPECTROSCOPY COAL TEST 201-1 SAMPLE B (μg/g)

U		Dy		Rh		Cr	47
Th		Tb		Ru		V	44
Bi		Gd		Mo	348	Ti	
Pb	95	Eu		Nb		Sc	
Tl		Sm		Zr	215	Ca	720
Hg		Nd		Y		K	
Au		Pr		Sr	64	Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se	77	Si	
Re		Cs		As	133	Al	12,100
W		I		Ge		Mg	300
Ta		Te		Ga		Na	
Hf		Sb	90	Zn	64	F	
Lu		Sn		Cu	46	B	NR
Yb		In		Ni	51	Be	NR
Tm		Cd	4	Co	152	Li	
Er		Ag		Fe	13,750		
Ho		Pd		Mn	11		

NR = None reported.

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-12. SPARK SOURCE MASS SPECTROSCOPY
COAL TEST 201-1 SAMPLE A
(μg/g)

U		Dy		Rh		Cr	49
Th		Tb		Ru		V	49
Bi		Gd		Mo	238	Ti	
Pb	77	Eu		Nb		Sc	
Tl		Sm		Zr	325	Ca	820
Hg	--	Nd		Y		K	
Au		Pr		Sr	72	Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se	68	Si	
Re		Cs		As	140	Al	15,900
W		I		Ge		Mg	400
Ta		Te		Ga		Na	
Hf		Sb	80	Zn	48	F	
Lu		Sn		Cu	98	B	NR
Yb		In		Ni	23	Be	NR
Tm		Cd	3	Co	102	Li	
Er		Ag		Fe	10,750		
Ho		Pd		Mn	13		

NR = None reported.

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-13. SPARK SOURCE MASS SPECTROSCOPY
FUEL OIL, TEST 202-4
(ppm)

U		Dy		Rh		Cr	
Th		Tb		Ru		V	
Bi		Gd		Mo		Ti	
Pb		Eu		Nb		Sc	
Tl		Sm		Zr		Ca	
Hg		Nd		Y		K	
Au		Pr		Sr		Cl	
Pt		Ce		Rb		S	
Ir		La		Br		P	
Os		Ba		Se		Si	
Re		Cs		As		Al	
W		I		Ge		Mg	
Ta		Te		Ga		Na	
Hf		Sb		Zn		F	
Lu		Sn		Cu		B	
Yb		In		Ni		Be	<0.05*
Tm		Cd		Co		Li	
Er		Ag		Fe			
Ho		Pd		Mn			

*Performed by SSMS on a feed oil sample from test 203.

NOTE: These values are approximate values as determined by spark source mass spectrometry (SSMS). The missing values were determined by inductively coupled plasma optical emission spectroscopy (ICPOES) analysis and are reported in the "additional data" section.

TABLE 3-14. ATOMIC ABSORPTION ANALYSIS COAL FIRING, TEST 201-1 (mg/m^3)

Sample	As	Hg	Sb
Scrubber inlet		0.011	
Scrubber outlet		0.005	

TABLE 3-15. ATOMIC ABSORPTION ANALYSIS OIL FIRING, TEST 202-4 (mg/m^3)

Sample	As	Hg	Sb
Scrubber inlet		0.0016	
Scrubber outlet		0.0002	

TABLE 3-16. ATOMIC ABSORPTION ANALYSIS FUEL OIL (ppm)

Sample	As	Hg	Sb
202-4		0.09*	

*Performed by cold vapor analysis on a feed oil sample from test 203.

TABLE 3-17. SULFUR GAS EMISSIONS FROM COAL FIRING
(mg/m^3)

	SO_2	SO_3	$SO_4^=$
202-1 inlet	2582	20.6	
202-1 outlet	88.5	14.6	
202-4 inlet	2689.2	25.8	70.4
202-4 outlet	59.2	18.6	28.0

TABLE 3-18. SULFUR GAS EMISSIONS FROM COAL FIRING
($\mu g/m^3$)

	SO_2	SO_3	$SO_4^=$
201-1 Inlet	2,970,000	16,900	154,100
201-1 Outlet	90,000	11,700	19,100
201-4 Inlet	2,420,000	12,600	
201-4 Outlet	130,000	9,000	

TABLE 3-19. ANION ANALYSIS
COAL FIRING TEST 201-1
($\mu g/m^3$)

Sample	F^-	Cl^-	NO_3^-	$SO_4^=$
Inlet*	510	10,900	<1,100	
Outlet*	<76	<9	<580	

*Mass as the ion.

TABLE 3-20. NITROGEN OXIDE GASES SCRUBBER INLET (ppm)

Test no.	Average NO_x as NO_2
200	515
201-1	591
201-2	539
201-3	395
201-4	547

TABLE 3-21. NITROGEN OXIDE GASES SCRUBBER OUTLET (ppm)

Test no.	Average NO_x as NO_2
200	456
201-1	551
201-2	424
201-3	309
201-4	564

TABLE 3-22. ANION ANALYSIS
INLET AND OUTLET OF FGD, HNO_3 EXTRACT
(mg/m^3)

Site	F^-	Cl^-	NO_3^-	$SO_4^=$
201-1 Inlet	0.012	9.262	NR	117.4
201-1-0 Inlet	<0.006	<0.004	NR	0.5
202-4 Inlet	0.009	<0.006	NR	30.7
202-4 Outlet	<0.002	<0.006	NR	3.5

NR = None reported.

TABLE 3-23. ANION ANALYSIS
INLET AND OUTLET OF FGD, HOT WATER EXTRACT
(mg/m^3)

Site	F^-	Cl^-	NO_3^-	$SO_4^=$
201-1 Inlet	0.503	1.605	<1.14	36.7
201-1-0 Inlet	<0.070	<0.005	<0.585	18.6
202-4 Inlet	0.045	0.463	0.235	39.7
202-4 Outlet	0.006	0.223	0.102	24.5

TABLE 3-24. ANION ANALYSIS
OIL FIRING, TEST 202-4
(mg/m^3)

Sample	F^-	Cl^-	NO_3^-	$SO_4^=$
Inlet*	0.054	0.46-0.47	0.24	
Outlet*	0.006-0.008	0.22-0.23	0.102	

*Mass as the ion.

TABLE 3-25. FIELD WATER ANALYSIS, COAL FIRING, TEST 200

Parameter	Assigned concentration
pH	7.9
Hard ($CaCO_3$)	210 mg/L
Alk ($CaCO_3$)	115 mg/L
Cyanide	0 mg/L

TABLE 3-26. FIELD WATER ANALYSIS, COAL FIRING, TEST 201-1

Parameter	Assigned concentration
pH	7.5
Hard ($CaCO_3$)	158 mg/L
Alk ($CaCO_3$)	125 mg/L
Cyanide	0 mg/L

TABLE 3-27. FIELD WATER ANALYSIS COAL FIRING, TEST 201-2

Parameter	Assigned concentration
pH	8.2
Hard ($CaCO_3$)	135 mg/L
Alk ($CaCO_3$)	130 mg/L
Cyanide	0 mg/L

TABLE 3-28. FIELD WATER ANALYSIS COAL FIRING, TEST 201-3

Parameter	Assigned concentration
pH	8.0
Hard ($CaCO_3$)	145 mg/L
Alk ($CaCO_3$)	125 mg/L
Cyanide	0 mg/L

TABLE 3-29. FIELD WATER ANALYSIS, COAL FIRING, TEST 201-4

Parameter	Assigned concentration
pH	7.3
Hard ($CaCO_3$)	100 mg/L
Alk ($CaCO_3$)	145 mg/L
Cyanide	0 mg/L

TABLE 3-30. FIELD WATER ANALYSIS, OIL FIRING, TEST 202-1

Parameter	Assigned concentration
pH	7.5
Hard ($CaCO_3$)	105 mg/L
Alk ($CaCO_3$)	135 mg/L
Cyanide	0 mg/L

TABLE 3-31. FIELD WATER ANALYSIS, OIL FIRING, TEST 202-2

Parameter	Assigned concentration
pH	6.5
Hard ($CaCO_3$)	140 mg/L
Alk ($CaCO_3$)	65 mg/L
Cyanide	0 mg/L

TABLE 3-32. FIELD WATER ANALYSIS, OIL FIRING, TEST 202-3

Parameter	Assigned concentration
pH	7.5
Hard ($CaCO_3$)	155 mg/L
Alk ($CaCO_3$)	120 mg/L
Cyanide	0 mg/L

TABLE 3-33. FIELD WATER ANALYSIS, OIL FIRING, TEST 202-4

Parameter	Assigned concentration
pH	6.5
Hard ($CaCO_3$)	150 mg/L
Alk ($CaCO_3$)	50 mg/L
Cyanide	0 mg/L

TABLE 3-34. FIELD WATER ANALYSIS, OIL FIRING, TEST 203

Parameter	Assigned concentration
pH	6.9
Hard ($CaCO_3$)	110 mg/L
Alk ($CaCO_3$)	140 mg/L
Cyanide	0 mg/L

TABLE 3-35. GAS CHROMATOGRAPHY ANALYSIS COAL-FIRING WASTEWATER

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	ND	
GC8	110-140	ND	
GC9	140-160	ND	
GC10	160-180	0.1	
GC11	180-200	ND	
GC12	200-220	ND	
GC13		ND	
GC14		0.1	
GC15		0.1	
GC16		ND	
GC17			

ND = Not detectable.

TABLE 3-36. GAS CHROMATOGRAPHY ANALYSIS OIL-FIRING WASTEWATER

Gas	Range	Volatile weight, ppm	No. of peaks
GC7	90-110	ND	
GC8	110-140	ND	
GC9	140-160	ND	
GC10	160-180	<0.1	
GC11	180-200	ND	
GC12	200-220	ND	
GC13		ND	
GC14		<0.1	
GC15		<0.1	
GC16		ND	
GC17			

ND = Not detectable.

Note that the following photographs were reproduced in the report, but that such photos were not duplicated for the data compilation.

SEM-EDX of partially fused fly ash from 201-1-Fly Ash

SEM-EDX of iron oxide particle from 201-1-Fly Ash

SEM photo of a cenosphere from 201-1-I Cyclone

SEM photo of $CaSO_3$. ½ H_2O laths impacted on fly ash cenosphere

SEM photo of typical aggregates found in 201-Scrubber Cake

1000X SEM photo of spherelites found in 204-4-Scrubber Cake

600X SEM photo of "ball of twine" in 202-4-Scrubber Cake

Note that the following TGA SCAN graphs were available in the report but were not copied for this data compilation.

201-1-I-Filter

201-1-I-Cyclone

202-4-I-Cyclone

201-1-Scrubber Cake

202-4 Filter Cake

Note that the following PLM photographs were available in the report, but were not copied for this data compilation.

201-1-0

202-4-0

201-1-Scrubber Cake

201-1-Fly Ash

201-1-I-Filter

201-1-I-Cyclone

202-4-I-Cyclone

202-4-Scrubber Cake

201-Fly Ash

202-4-I

Note that the following FTIR SPECTRA were available in the report, but were not copied for this data compilation.

TRW-201-1-I-Cyclone - Min. Oil FCR. 09744

TRW-201-1-Filter Corrected for Mineral Oil Triple Subtraction Results
    201-1-0 (Minus Blank) Minus
    201-1-I (Minus Mineral Oil)

TRW 201-1-Fly Ash-Corrected for Min. Oil
TRW 201-1-Scrubber Cake Corrected for Min. Oil

TRW 202-4-I-Cyclone - Min. Oil FCR. 05225

TRW Sample Fly Ash Blank - Corrected for Min. Oil

TRW-202-4-Scrubber Cake-Min. Oil FCR. 04177

Triple Subtraction Results
    202-4-0 Filter (Minus Blank)
    Minus 202-4-1 (Minus Blank)

Subtraction Results
    202-4-0 Filter Minus Filter Blank

Subtraction Results
    202-4-1 Filter Minus Filter Blank

Subtraction Results
    202-1-0 Filter Minus Filter Blank

Note that the following ESCA SPECTRA were available in the report, but were not copied for this data compilation.

201-1-I Cyclone

201-1-I Filter

201-1-I FP 75 A SP

201-1-0-Filter

201-1-0 76 A SP

201-1-0 160 A SP

201-1-0 300 A SP

201-1-0 500 A SP

201-1-0 760 A SP

201-1-Fly Ash

201-1-Scrubber Cake

202-4-I Cyclone

202-4-I Filter

202-4-I Filter 76 A SP

202-4-I Filter

202-4-0 Filter

202-4-0 76 A SP

202-4-0 76 A SP

202-4-Scrubber Cake

Note that the following SIM DATA DEPTH PROFILE PLOTS were available in the report, but were not copied for this data compilation.

201-1-I Cyclone

201-1-I Loose Filter

201-1-0-PF

202-4-I-Cyclone

202-4-I-Paper 5

202-4-0 Filter

201-1-I FC

202-4 Scrubber Cake

TABLE 3-37
LC Analysis Results

	TCO mg	GRAV mg	TCO + GRAV Total mg	Concentration mg/ (m^3, L, or kg)[5]
Total Sample[1]				1.52
Taken for LC[2]				
Recovered[3]				

Fraction	TCO in mg				GRAV in mg				TCO + GRAV Total mg	Concentration mg/ (m^3,L, or kg)[5]
	Found in Fraction	Blank	Corrected	Total[4]	Found in Fraction	Blank	Corrected	Total[4]		
1										0.12
2										--
3										0.03
4										0.11
5										0.35
6										0.85
7										0.06
Sum										1.52

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Supply values for both sample size and concentration

LEVEL 2

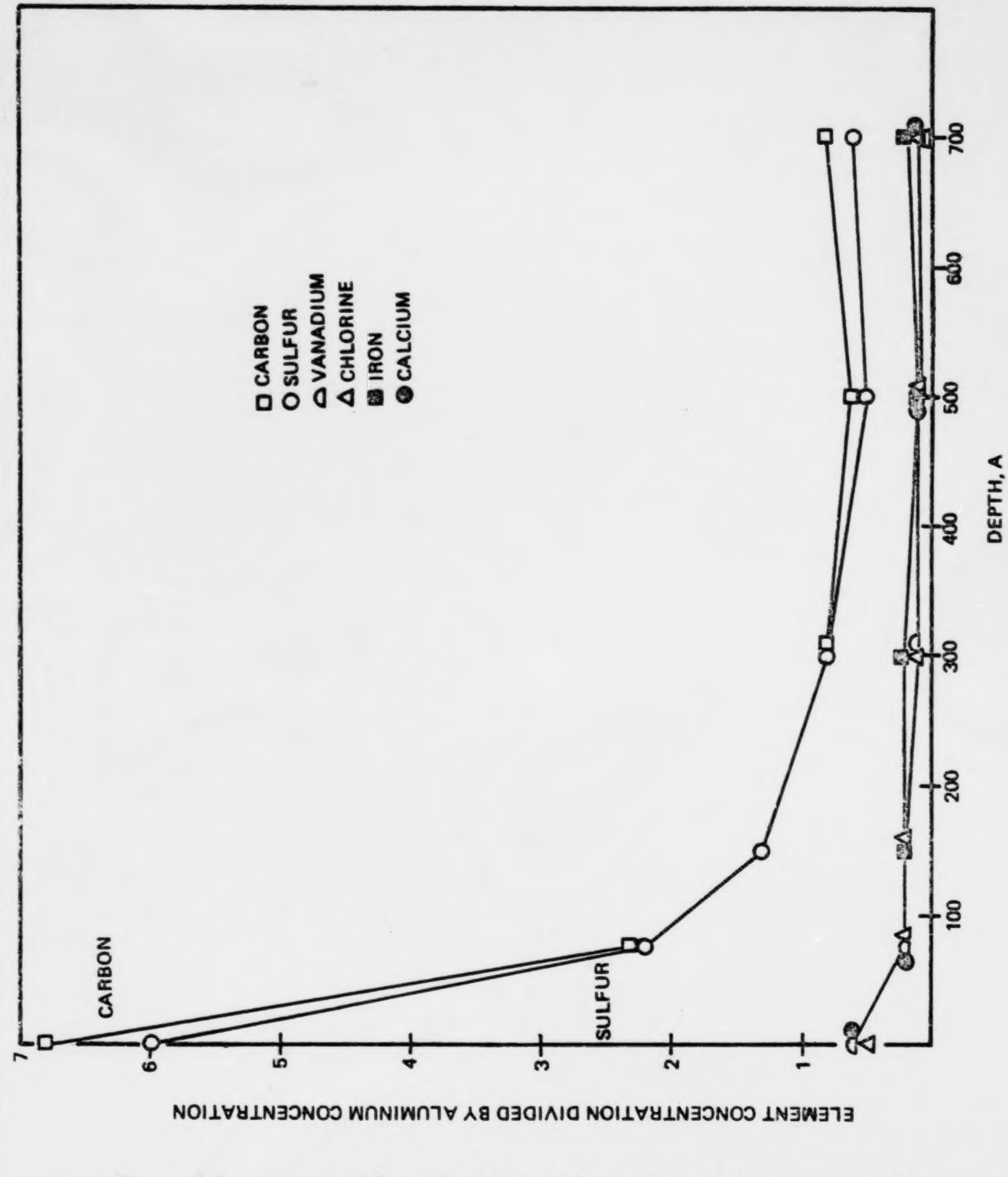

Figure 5-2. Depth profile analysis of outlet coal particulate - Test 201-1.

TABLE 1. ORGANIC ANALYSIS RESULTS

COMPOUND NAME	FRACTION	ug/m^3							
		Oil				Coal			
		201-2		201-3		202-2		202-3	
		IN	OUT	IN	OUT	IN	OUT	IN	OUT
Propionaldehyde	GB	170	380	54	-	200	-	142	-
Nitromethane	GB	-	-	-	-	-	-	63	-
Ethyl-n-butyl ether	GB	2000	1500	910	1500	1700	-	1000	-
Ethyl acetate	GB	-	-	-	-	-	-	-	2300
Hydrocarbon (C_6H_{14})	GB	-	-	380	-	-	-	-	-
Chloropropanol	PR	-	-	-	3.9	-	-	-	-
4-methyl-3-pentene-2-one*	PR	-	-	-	-	-	570	350	28
Unidentified alcohol	PR	-	4.0	-	-	-	-	-	-
Octanol	PR	-	-	-	-	-	-	45	-
Ketone (MW 138)*	PR	-	-	-	-	-	-	20	-
Ketone (MW 140)	PR	3.9	-	6.9	-	14	-	-	-
Phthalic anhydride	PR	-	-	-	-	-	-	29	-
Amyl benzoate	PR	—	-	-	-	-	1.6	-	-
Glycerol triacetate	PF	-	-	-	-	-	-	42	-
Methyl sub aromatic	XR	1.7	-	-	-	-	-	-	-

GB = Grab bag samples

PR = Probe rinse

TABLE 9. SURFACE ATOM PERCENT FROM ESCA DATA

Sample*	O	Na	S	Si	Al	Fe	Cl	P	V	Ca	C	K
201-1-I Cyclone	57	4	11	6	7	2	2	1				
201-1-I Filter	56	2.4	11.5	14.1	8	1.4	1.5	1.2		2		
201-1-I Filter 76 Å SP	54.2	2.1	4.0	17.9	12.6	2.1	1.3	2.2	1.0	2.7		
201-1-0 Filter	45.7	5.5	13.2	7.1	2.2		1.2	1.1	0.7	1.3	14.9	7.1
201-1-0 75 Å SP	48	7.4	11.5	9.0	5.2	1.2	1.1	1.1		1.1	12.1	1.8
201-1-0 150 Å SP	48.3	9.1	10.0	10.1	7.7	1.2	1.2	1.2			10.0	1.2
201-1-0 300 Å SP	48.3	8.8	8.0	10.6	9.6	2.1	1.0	1.2	0.5		8.0	1.8
201-1-0 500 Å SP	47.9	7.3	6.7	10.8	13	1.7	1.2	1.1		1.2	8.1	1.1
201-1-0 750 Å SP	47	7.3	6.1	11.6	11.0	2.3	0.9	1.5	0.5	1.0	8.8	1.6
201-1 Flyash	44.6	2.6	7.6	13.9	7.5	1.2	1.2	1.2	0.4		18.1	1.6
201-1 Scrubber Cake	47	10.0	14.8	3.2	3.7	0.6	1.5	0.9		5.8	9.9	2.6
202-4-I Cyclone	38.5	3.2	12.9	2.6	2.3		1.4	0.6	1.2		37.4	
202-4-I Filter	48.6	4.2	10.7	11.8	3.1		1.3	1.5	1.7		17.2	
202-4-I Filter 76 Å SP	46.3	4.7	6.5	17.1	3.3	0.8	1.4	1.1	3.3	0.9	12.9	1.7
202-4-0 Filter	46.6	5.8	9.9	14.9	3.5	1.3	2.4	1.7	1.8		14.5	
202-4-0 Filter 76 Å SP	53.5	3.2	6.8	22.0	4.0		1.3	1.0	2.0		6.2	
202-4-SC	41	9.8	15.3	2.1	2.3	1.7	2.1	1.1	1.4	6.5	12.7	3.6
Filter Blank	38.4	5.8	7.5	24.7	1.8	1.1	1.6	1.1	0.9		17.2	
Filter Blank 75 Å SP	47.3	8	2	28.5	3.2		0.9	2.6	0.6	1.2	4.4	1.3

*Å SP refers to Depth of Ar^+ sputtering in Å.

TABLE 5-4. CONCENTRATION OF MAJOR TRACE ELEMENTS IN COAL-TEST 201-1

Element	µg/g Coal				Reference
	Sample A	Sample B	Average	Typical Range[†]	
Ca	820	720	770	0 - 1600	2,4
Mg	400	300	350	0 - 959	2,4
Sb	80	90	85	0.2 - 8.9	2
As	140	133	137	0.5 - 93	1,2
B	-	-	2.4[*]	4 - 115	1,3
Cd	3	4	3.5	0.1 - 65	2
Cr	49	47	48	4 - 144	1,3
Co	102	152	127	0.5 - 43	1,2
Cu	98	46	72	3 - 61	1,2
Fe	10,750	13,750	12,250	0.3 - 40,000	2,4
Pb	77	95	85	4 - 218	1,2
Mn	13	11	12	6 - 181	2
Mo	238	348	293	0.4 - 30	1,2
Ni	23	51	37	2 - 80	1,2
V	49	44	47	2 - 147	1,2,3
Zn	48	64	56	6 - 5,350	2
Se	68	77	73	0.4 - 74	2,3
Sr	72	64	68	NO DATA	
Al	15,900	12,100	14,000	0.4 - 40,700	2,4
Zr	325	215	270	8 - 133	2
Be	-	-	2.3[*]	0.6 - 4.1	1
Hg	-	-	0.14[‡]	0.07 - 0.49	1

[*] Boron and beryllium analysis were performed by SSMS on a feed coal sample from test 200.

[†] Typical range for Appalachian and Eastern Interior Basin coals.

[‡] Mercury was determined by cold vapor analysis of a coal sample from test 200.

TABLE 5-20. DEPTH PROFILE ANALYSIS OF COAL PARTICULATE WITH CONCENTRATIONS EXPRESSED AS NORMALIZED ATOM PERCENT* - TEST 201-1

		O	Na	S	Si	Al	Fe	Cl	P	V	Ca	C	K
Inlet	Level II cyclone catch	57	4	11	6	7	2	2	1				
	Level II filter catch	56	2.4	11.5	14.1	8	1.4	1.5	1.2		2		
	Level II filter catch; 76 Å	54.2	2.1	4.0	17.9	12.6	2.1	1.3	2.2	1.0	2.7		
Outlet	Level II filter catch	45.7	5.5	13.2	7.1	2.2		1.2	1.1	0.7	1.3	14.9	7.1
	Level II filter catch; 75 Å	48	7.4	11.5	9.0	5.2	1.2	1.1	1.1		1.1	12.1	1.8
	Level II filter catch; 150 Å	48.3	9.1	10.0	10.1	7.7	1.2	1.2	1.2			10.0	1.2
	Level II filter catch; 300 Å	48.3	8.8	8.0	10.6	9.6	2.1	1.0	1.2	0.5		8.0	1.8
	Level II filter catch; 500 Å	47.9	7.3	6.7	10.8	13	1.7	1.2	1.1		1.2	8.1	1.1
	Level II filter catch; 700 Å	47	7.3	6.1	11.6	11.0	2.3	0.9	1.5	0.5	1.0	8.8	1.6

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* The atom percent of the 12 elements presented here adds up to 100 percent. Other elements present in the cyclone and filter catches were not studied in ESCA. Hence, the atom percents in this table are normalized atom percents and not absolute atom percents.

TABLE 4-14. EMISSION CONCENTRATIONS OF TRACE ELEMENTS DURING COAL FIRING - TEST 201-1

Trace Element	Scrubber Inlet mg/m^3	Scrubber Outlet mg/m^3	MATE Value mg/m^3	Degree of Hazard[‡]	
				Scrubber Inlet	Scrubber Outlet
Be[*]	0.1	0.002	0.002	50	1.0
Hg[†]	0.011	0.005	0.05	0.22	0.10
Ca	74	0.036	16	4.6	0.002
Mg	19	0.011	6.0	3.2	0.002
Sb	3.7	0.025	0.050	74	0.5
As	7.8	0.22	0.002	3900	110
B[*]	0.2	0.03	3.1	0.07	0.01
Cd	0.47	0.0010	0.010	47	0.1
Cr	2.6	0.13	0.001	2600	130
Co	3.6	0.012	0.050	72	0.24
Cu	9.6	0.020	0.20	48	0.10
Fe	450	2.4	1.0	450	2.4
Pb	8.5	0.021	0.15	57	0.14
Mn	0.78	0.015	5.0	0.16	0.003
Mo	10	0.027	5.0	2.0	0.005
Ni	1.4	0.063	0.015	93	4.2
V	3.1	0.058	0.50	6.2	0.12
Zn	2.3	0.048	4.0	0.58	0.012
Se	3.2	0.099	0.200	16	0.50
Sr	11	0.058	3.1	3.5	0.019
Al	480	2.6	5.2	92	0.5
Zr	1.6	0.018	5.0	0.32	0.004
Total	1100	6.2			

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[*] Approximate values as determined by Spark Source Mass Spectrometry (SSMS). The other values presented are determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICPOES) analysis.

[†] Mercury was determined by cold vapor analysis of SASS train.

[‡] Degree of hazard is defined as the ratio of the discharge concentration to the MATE value.

TABLE 4-15. EMISSION CONCENTRATIONS OF TRACE ELEMENTS DURING OIL FIRING - TEST 202-4

Element	Scrubber Inlet mg/m^3	Scrubber Outlet mg/m^3	MATE Value mg/m^3	Degree of Hazard	
				Scrubber Inlet	Scrubber Outlet
Be[*]	<0.001	0.001	0.002	<0.50	0.50
Hg[†]	0.0016	0.0002	0.05	0.032	0.004
Ca	0.41	0.070	16	0.026	0.004
Mg	0.31	0.030	6.0	0.052	0.005
Sb	0.062	0.006	0.050	1.24	0.120
As	0.15	0.030	0.002	75.0	15.0
B	0.53	0.039	3.1	0.171	0.013
Cd	0.28	0.066	0.010	28.0	6.60
Cr	0.17	0.018	0.001	170	18.0
Co	0.10	0.012	0.050	2.0	0.24
Cu	0.54	0.007	0.20	2.70	0.035
Fe	4.8	0.28	1.0	4.8	0.28
Pb	0.20	0.013	0.15	1.333	0.087
Mn	0.03	0.004	5.0	0.006	0.001
Mo	0.22	0.025	5.0	0.044	0.005
Ni	1.1	0.20	0.015	73.3	13.33
V	2.7	0.82	0.50	5.40	1.640
Zn	0.61	0.065	4.0	0.153	0.016
Se	0.050	0.006	0.200	0.25	0.03
Sr	0.043	0.001	3.1	0.014	0.0003
Al	5.7	0.48	5.2	1.096	0.092
Zr	0.015	0.001	5.0	0.003	0.0002
Total	18	2.5			

[*] Beryllium was determined by Spark Source Mass Spectrometry (SSMS). The other values, with the exception of mercury, are determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICPOES) analysis.

[†] Mercury was determined by cold vapor analysis of SASS train samples taken during test 203.

TABLE 4-16. EMISSION FACTORS AND MASS EMISSION RATES OF TRACE ELEMENTS DURING COAL FIRING - TEST 201-1

Trace Element	Emission Factor, ng/J		Emission Rate, g/hr		Removal Efficiency %	Enrichment Factor
	Scrubber Inlet	Scrubber Outlet	Scrubber Inlet	Scrubber Outlet		
Be[*]	0.04	0.001	5	0.09	98	3.7
Hg[†]	0.08	0.037	0.50	0.23	55	84
Ca	32	0.015	3300	1.6	99	0.09
Mg	8.2	0.0046	860	0.48	99	0.11
Sb	1.6	0.010	170	1.1	99	1.2
As	3.4	0.092	350	9.7	97	5.3
B[*]	0.1	0.01	10	1.2	88	2.1
Cd	0.20	0.00042	21	0.044	99	0.4
Cr	1.1	0.054	120	5.7	95	9.5
Co	1.6	0.0050	160	0.53	99	0.6
Cu	4.1	0.0084	430	0.88	99	0.4
Fe	190	1.0	20,000	110	99	0.99
Pb	3.7	0.0088	380	0.92	99	0.5
Mn	0.34	0.0063	35	0.68	98	3.4
Mo	4.3	0.026	450	1.2	99	0.5
Ni	0.60	0.026	61	2.8	95	8.6
V	1.3	0.024	140	2.5	98	3.6
Zn	0.99	0.020	100	2.1	98	3.9
Se	1.4	0.041	140	4.3	97	5.8
Sr	4.7	0.024	500	2.5	99	0.9
Al	210	1.1	22,000	110	99	1.0
Zr	0.69	0.0075	72	0.79	99	2.1
Total	470	2.6	50,000	270	99	

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[*] Appropriate values as determined by SSMS. The other values, with the exception of mercury, were determined by ICPOES analysis.

[†] Mercury was determined by cold vapor analysis of SASS train samples taken during test 200.

TABLE 4-17. EMISSION FACTORS AND MASS EMISSION RATES OF TRACE ELEMENTS DURING OIL FIRING - TEST 202-4

Element	Emission Factor, ng/J		Emission Rate, gm/hr		Removal Efficiency %	Enrichment Factor
	Scrubber Inlet	Scrubber Outlet	Scrubber Inlet	Scrubber Outlet		
Be*	<0.0003	0.0003	<0.04	0.04	Unknown	>11.9
Hg†	0.0006	0.0001	0.05	0.006	87	1.48
Ca	0.13	0.022	16	2.7	83	2.03
Mg	0.10	0.0094	12	1.1	91	1.15
Sb	0.02	0.0019	2.5	0.23	91	1.15
As	0.049	0.0094	5.9	1.1	81	2.37
B	0.17	0.012	21	1.5	93	0.87
Cd	0.091	0.021	11	2.5	77	2.80
Cr	0.055	0.0057	6.7	0.69	90	1.26
Co	0.033	0.0038	3.9	0.46	89	1.43
Cu	0.18	0.002	21	0.27	99	0.15
Fe	1.6	0.088	190	11	95	0.69
Pb	0.065	0.0041	7.9	0.50	94	0.77
Mn	0.010	0.0013	1.2	0.15	87	1.58
Mo	0.072	0.0079	8.7	0.95	89	1.35
Ni	0.36	0.063	43	7.7	83	2.16
V	0.88	0.26	110	31	71	3.61
Zn	0.20	0.02	24	2.5	90	1.27
Se	0.016	0.002	2.0	0.23	87	1.43
Sr	0.014	0.0003	1.7	0.038	98	0.28
Al	1.9	0.15	220	18	92	1.0
Zr	0.0049	0.0003	0.59	0.038	94	0.79
Total	6.0	0.78	710	96	87	

*Beryllium was determined by SSMS. The other elements, except fluorine, were determined by ICPOES.

†Mercury was determined by cold vapor analysis of SASS train samples taken during test 203.

TABLE 4-33. INORGANIC CONTENT OF SCRUBBER CAKE FROM COAL-FIRING (DRY BASIS) - TEST 201-1

Element	Concentration µg/g	MATE Value, µg/g		Degree of Hazard	
		Health	Ecology	Health	Ecology
Ca	60,715	480	32	126	1,897
Mg	1,458	180	174	8.1	8.4
Sb	315	15	0.4	21	788
As	532	0.5	0.1	1,064	5,320
B	88	93	50	0.9	1.8
Cd	13	0.1	0.002	130	6,500
Cr	141	0.5	0.5	282	282
Co	424	1.5	0.5	283	848
Cu	112	10	0.1	11	1,120
Fe	47,241	3.0	0.5	15,738	94,482
Pb	297	0.5	0.1	594	2,970
Mn	51	0.5	0.2	102	255
Mo	1,117	150	14	7.4	80
Ni	114	0.45	0.02	253	5,700
V	195	5.0	0.3	39	650
Zn	282	50	0.2	5.6	1,410
Se	256	0.10	0.05	2,560	5,120
Sr	642	92	--	7.0	--
Al	45,310	160	2.0	283	22,655
Zr	106	15	--	7.1	--
Total	159,409				

TABLE 4-34. INORGANIC CONTENT OF SCRUBBER CAKE FROM OIL FIRING (DRY BASIS) - TEST 202-4

Element	Concentration µg/g	MATE Value, µg/g		Degree of Hazard	
		Health	Ecology	Health	Ecology
Ca	200,000	480	32	417	6,250
Mg	3,799	180	174	21	22
Sb	3*	15	0.4	0.2	7.5
As	15*	0.5	0.1	30	150
B	40	93	50	0.4	0.8
Cd	1*	0.1	0.002	10	500
Cr	15	0.5	0.5	30	30
Co	19*	1.5	0.5	13	38
Cu	16	10	0.1	2	160
Fe	2,164	3.0	0.5	721	4,328
Pb	6*	0.5	0.1	12	60
Mn	6	0.5	0.2	32	80
Mo	14*	150	14	0.1	.1
Ni	132	0.45	0.02	293	6,600
V	203	5.0	0.3	41	677
Zn	36	50	0.2	0.7	180
Se	9*	0.10	0.05	90	180
Sr	239	92	--	2.6	--
Al	1,684	160	2.0	11	842
Zr	37	15	--	2.5	--
Total	208,450				

*SSMS analyses were utilized where ICPOES analysis provided upper limit data only.

TABLE 4-35. INORGANIC CONTENT OF FLY ASH FROM COAL-FIRING - TEST 201-1

Element	Concentration µg/g	MATE Value, µg/g		Degree of Hazard	
		Health	Ecology	Health	Ecology
Ca	378	480	32	0.8	12
Mg	2,478	180	174	14	14
Sb	438	15	0.4	29	1,095
As	1,015	0.5	0.1	2,030	10,150
B	20	93	50	0.2	0.4
Cd	18	0.1	0.002	180	9,000
Cr	434	0.5	0.5	868	868
Co	408	1.5	0.5	272	816
Cu	320	10	0.1	32	3,200
Fe	129,330	3.0	0.5	43,110	258,660
Pb	438	0.5	0.1	876	4,380
Mn	121	0.5	0.2	242	605
Mo	1,288	150	14	9	92
Ni	165	0.45	0.02	367	8,250
V	376	5.0	0.3	75	1,253
Zn	179	5.0	0.2	36	895
Se	378	0.10	0.05	3,780	7,560
Sr	728	92	--	8	--
Al	109,450	160	2.0	684	54,725
Zr	187	15	--	12	--
Total	248,149				

TABLE 4-36. MASS BALANCE ON TRACE ELEMENTS - TEST 201-1

Element	Coal Feed g/hr	Scrubber Cake g/hr	Scrubber Effluent Gas g/hr	Bottom and Fly Ash* g/hr	Percent Recovery†
Ca	2,794	40,072	1.6	30	‡
Mg	1,270	962	0.5	198	91
Sb	308	208	1.1	35	79
As	497	351	9.7	81	89
B	8.7	58	1.2	1.6	700
Cd	12.7	8.6	0.04	1.4	79
Cr	174	93	5.7	35	77
Co	461	280	0.53	33	68
Cu	261	74	0.88	26	39
Fe	44,455	31,179	110	10,346	94
Pb	308	196	0.92	35	75
Mn	44	34	0.68	9.7	100
Mo	1,063	737	1.2	103	79
Ni	134	75	2.8	13	68
V	171	151	2.5	30	107
Zn	203	186	2.1	14	100
Se	265	169	4.3	30	77
Sr	247	424	2.5	58	196
Al	50,806	29,905	110	8,756	76
Zr	980	70	0.79	15	9

* For mass balance calculations, bottom ash has been assumed to have the same trace element concentrations as fly ash. This is an approximate assumption, as some trace elements are enriched in the fly ash.

† Percent recovery is defined as the ratio of the sum of the emissions for a trace element to the trace element in the coal feed.

‡ Percent recovery for calcium is not calculated because most of the calcium in the scrubber cake is from the lime slurry.

TABLE 4-37. MASS BALANCE OF TRACE ELEMENTS - TEST 202-4

Element	Oil Feed g/min	Scrubber Cake g/min	Scrubber Outlet g/min	Percent[‡] Recovery
Ca	16.4	50,000	2.8	**
Mg	(12.2)[†]	950	1.2	>1,000
Sb	(2.4)	0.8*	0.2	42
As	(5.9)	3.9*	1.2	68
B	(20.9)	10.0	1.5	55
Cd	(11.0)	0.2*	2.6	25
Cr	3.6	3.9	0.7	125
Co	(3.9)	4.7*	0.5	133
Cu	4.2	4.1	0.3	105
Fe	36.7	541	11.0	>1,000
Pb	(7.9)	1.5*	0.5	25
Mn	(1.2)	4.0	0.2	350
Mo	(8.7)	3.5*	1.0	52
Ni	47.7	33.0	7.9	91
V	108.8	50.7	32.3	76
Zn	8.9	9.1	2.7	133
Se	(2.0)	2.4*	0.2	136
Sr	0.7	59.8	0.04	>1,000
Al	10.4	421	18.9	>1,000
Zr	(0.6)	9.2	0.04	>1,000

* SSMS data were utilized where ICPOES analysis provided upper limit data only.

[†] ICPOES data from the analysis of scrubber inlet particulates were utilized when fuel analysis provided upper limit data only.

[‡] Percent recovery of a trace element is 100 times the ratio of its total emission rate (scrubber cake plus scrubber outlet) to its feed rate.

** Percent recovery for calcium is not calculated because most of the calcium in the scrubber cake is from the lime slurry.

TABLE 5-13. COMPOSITION OF FGD SCRUBBER CAKE

Element	Concentration, μg/g Coal Firing	 Oil Firing	Relative Concentrations, Coal/Oil
Ca	60715	192030	.3
Mg	1458	1776	.8
Sb	315	122	2.6
As	532	135	3.9
B	857	2405	.4
Cd	13	7	1.9
Cr	141	33	4.3
Co	424	231	1.8
Cu	112	35	3.2
Fe	47241	3867	12.2
Pb	297	104	2.9
Mn	51	15	3.4
Mo	1117	666	1.7
Ni	114	148	.8
V	195	161	1.2
Zn	282	19	14.9
Se	256	128	2.0
Sr	642	163	3.9
Al	45310	4625	9.8
Zr	106	39	2.7

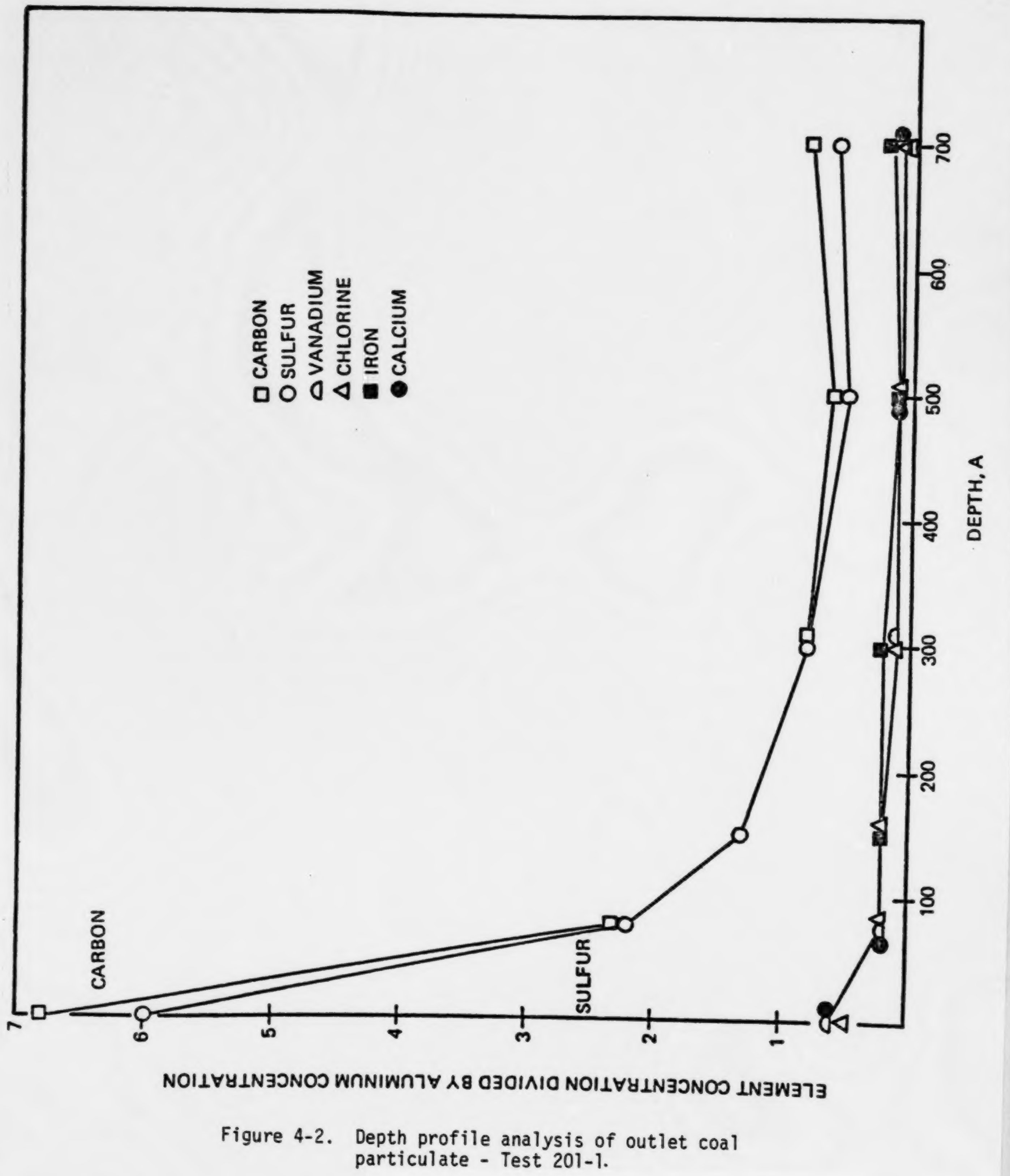


Figure 4-2. Depth profile analysis of outlet coal particulate - Test 201-1.

TABLE 4-38. ANNUAL EMISSIONS[*]

TABLE 4-38. ANNUAL EMISSIONS[*]

	Pollutant	Scrubber Inlet Coal Firing	Scrubber Inlet Oil Firing	Scrubber Inlet Coal/Oil	Scrubber Outlet Coal Firing	Scrubber Outlet Oil Firing	Scrubber Outlet Coal/Oil
		kg/year					
Gaseous	NO_x (as NO_2)	500,810	164,230	3.05	442,520	157,390	2.81
	SO_2	1,127,300	906,202	1.24	36,800	24,453	1.51
	$SO_3^=$	6,184	7,249	0.85	4,157	5,183	0.80
	$SO_4^=$	67,214	20,894	3.22	8,110	8,303	0.98
	CO	16,119	4,991	3.23	14,497	4,845	2.99
	Organics (as CH_4)	5,870	2,272	2.58	6,377	2,500	2.55
	$C_1 - C_6$[†]	<5,606	<4,164	--	<5,606	<4,164	--
	$C_7 - C_{16}$	345	155	2.22	274	18	15.2
	$>C_{16}$	2,311	2,381	0.97	335	392	0.85
	Total Particulates	2,991,700	53,832	55.6	18,856	13,606	1.38
	<1μ	--	--	--	11,691	11,359	1.03
	1 - 3μ	--	--	--	5,657	1,642	3.45
	3 - 10μ	--	--	--	1,320	634	1.93
	>10μ	--	--	--	188	0[‡]	--
		m^3/year					
Liquid	Blowdown/Waste Water	~76,000	~76,000	~ 1	~76,000	~76,000	~ 1
	Cooling Water	~86,000	~86,000	~ 1	~86,000	~86,000	~ 1
		kg/year					
Solid	Bottom Ash	~ 778,600	~ 7,600	~103	~ 778,600	~ 7,600	~103
	Fly Ash	~1,800,000	~15,000	~120	~1,800,000	~15,000	~120
	Scrubber Cake	0	0	--	8,054,100	3,011,000	2.67

[*] Assuming 100% load, 45 weeks per year (7,560 hrs/year).

[†] These values represent the detection limit of the instrument used.

[‡] These values represent oil firing particulate with a minimum of coal ash contamination.

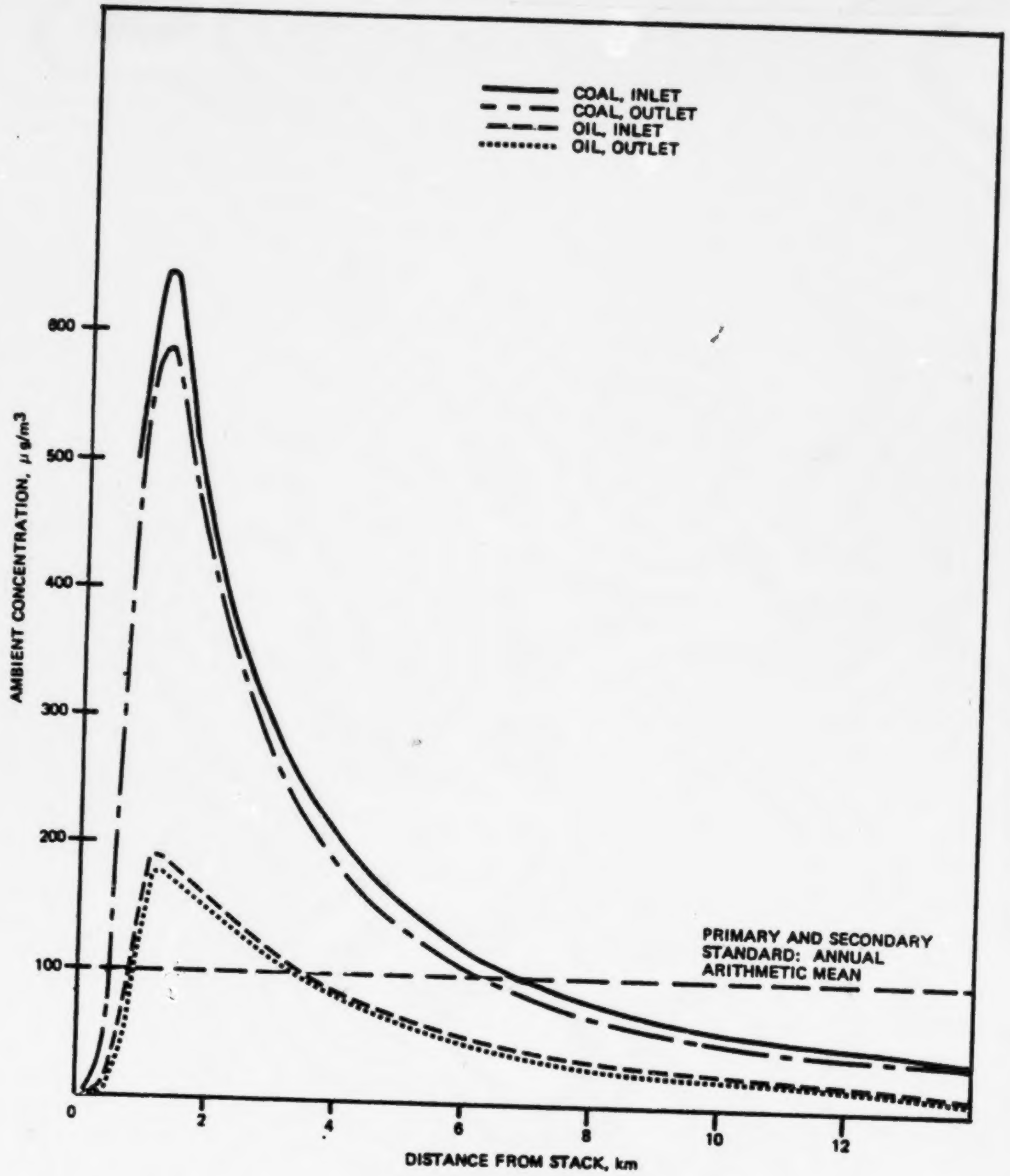


Figure 4-2. Comparison of NO_x Air Quality Resulting From Coal and Oil Firing Under Worst Case Weather Conditions (Tests 201-1 and 202-1)

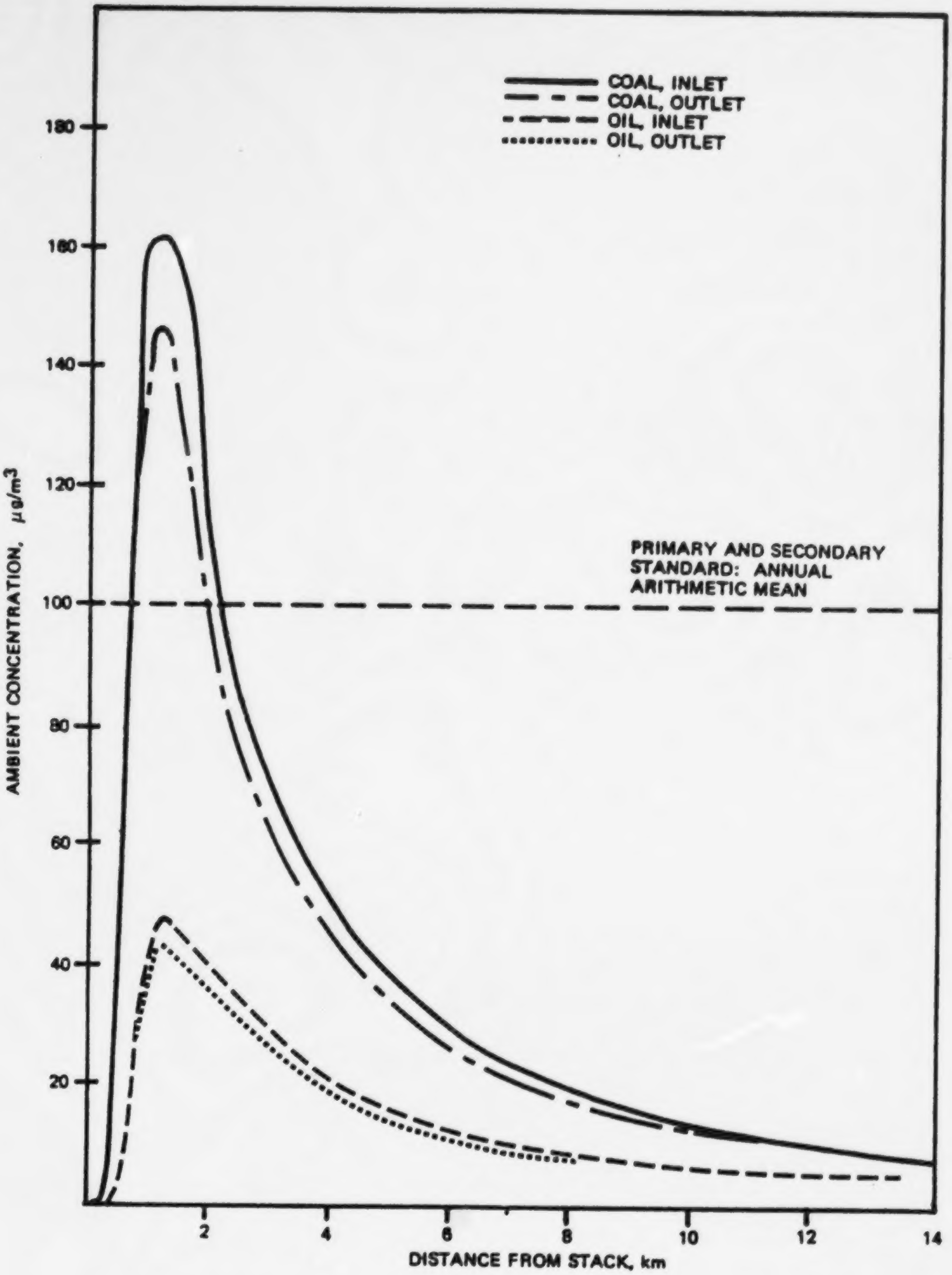


Figure 4-3. Comparison of NO_x Air Quality Resulting From Coal and Oil Firing Under Typical Weather Conditions (Tests 201-1 and 202-1)

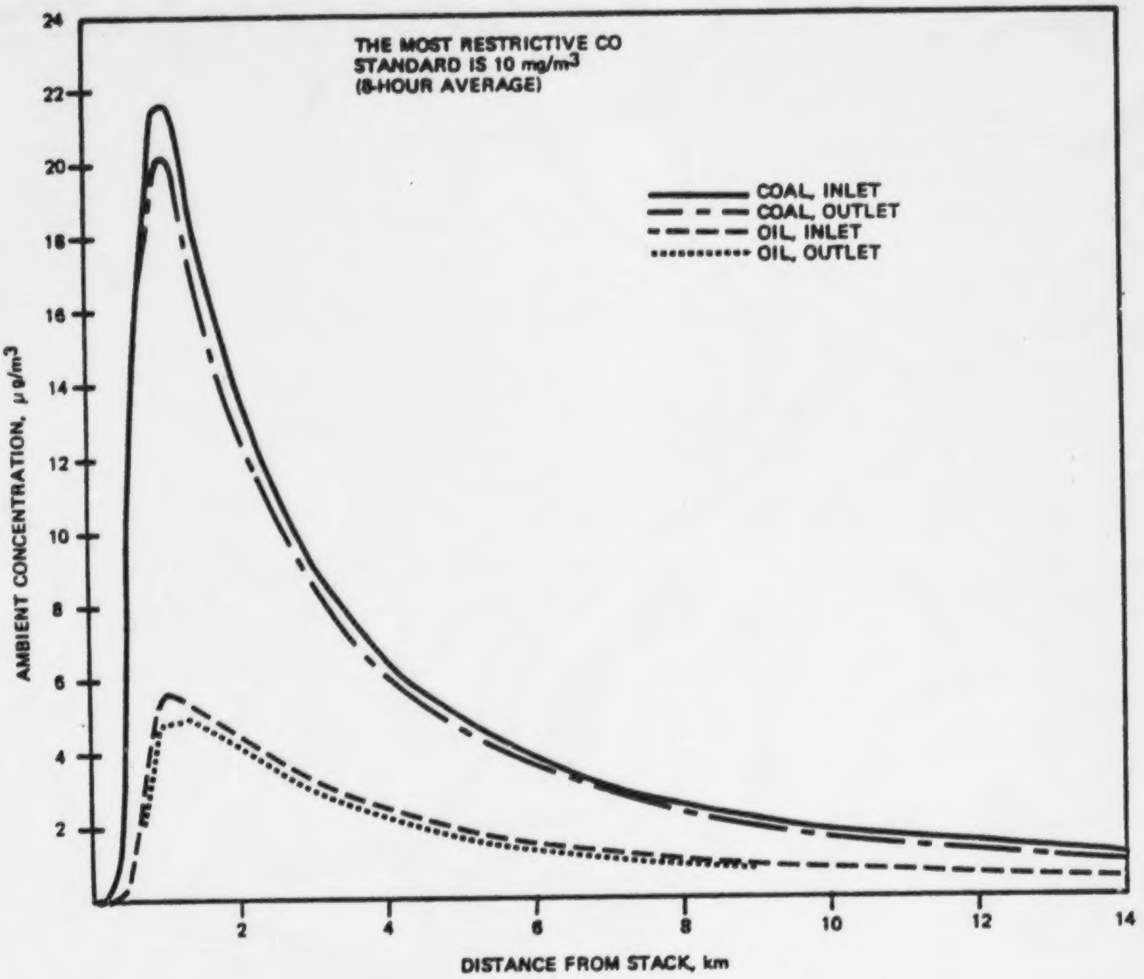


Figure 4-4. Comparison of CO Air Quality Resulting From Coal and Oil Firing Under Worst Case Weather Conditions (Tests 201-1 and 202-1)

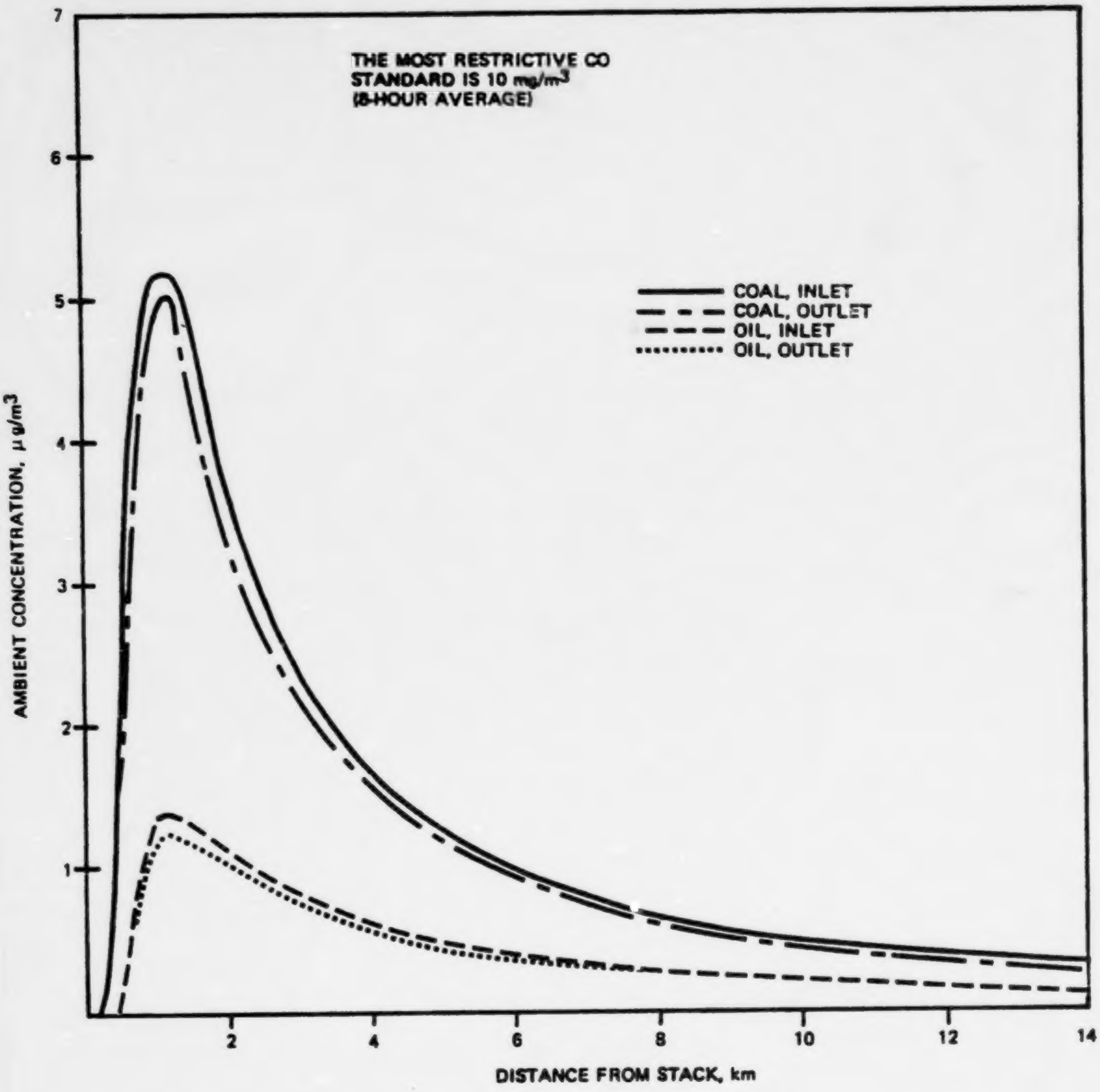


Figure 4-5. Comparison of CO Air Quality Resulting From Coal and Oil Firing Under Typical Weather Conditions (Tests 201-1 and 202-1)

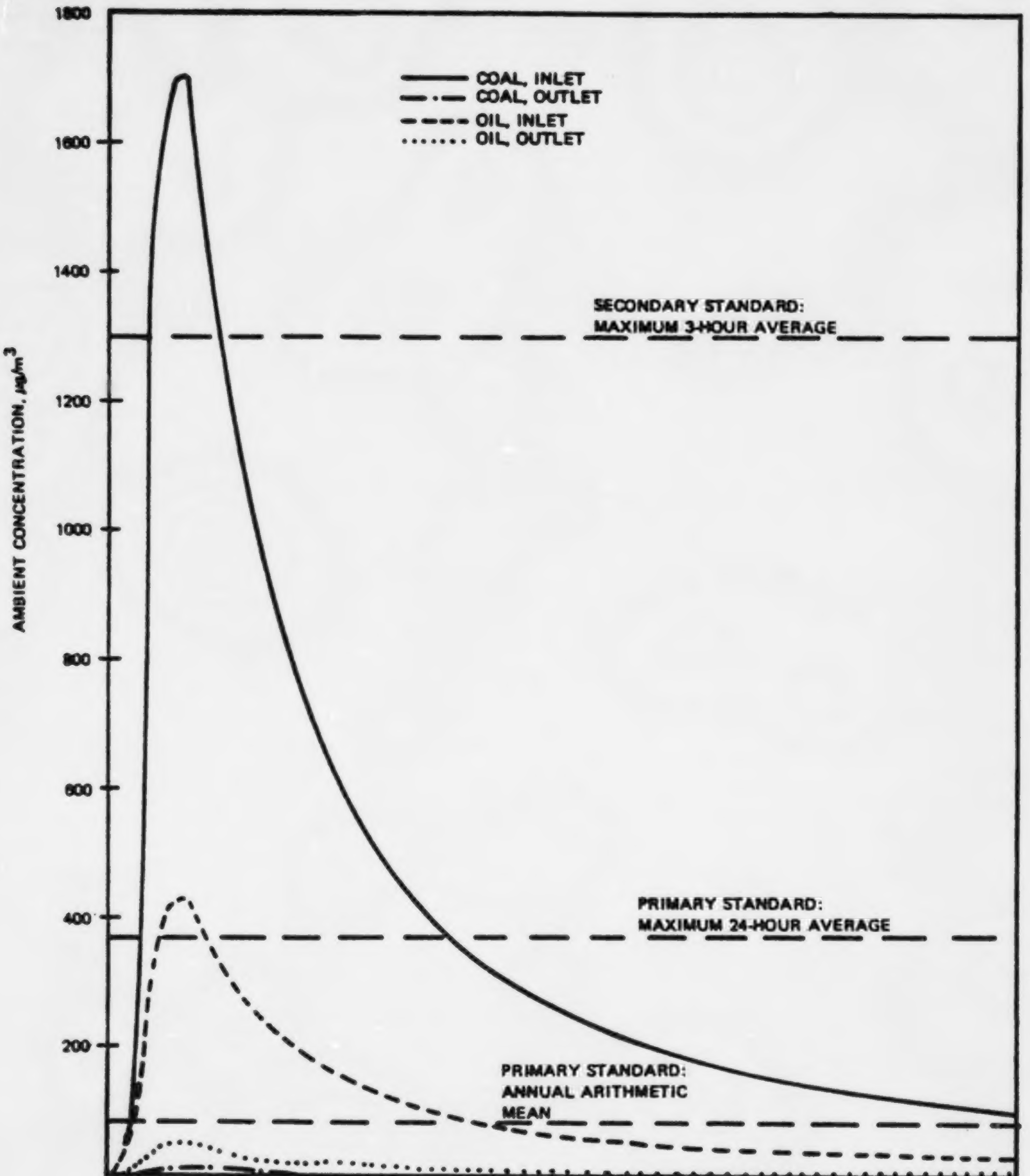


Figure 4-6. Comparison of SO_2 Air Quality Resulting from Coal and Oil Firing under Worst Case Weather Conditions (Tests 201-1 and 202-1)

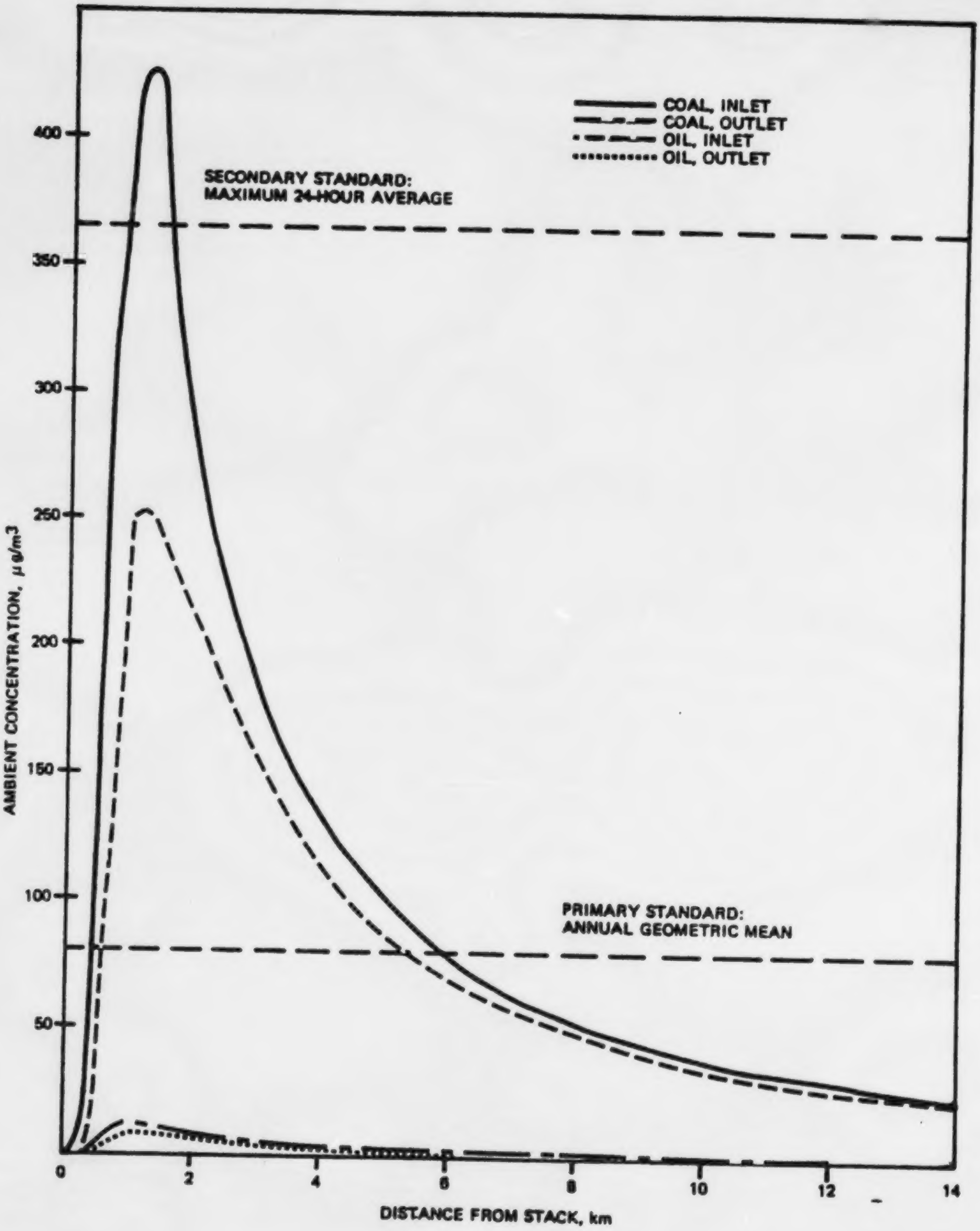


Figure 4-7. Comparison of SO_2 Air Quality Resulting From Coal and Oil Firing Under Typical Weather Conditions (Tests 201-1 and 202-1)

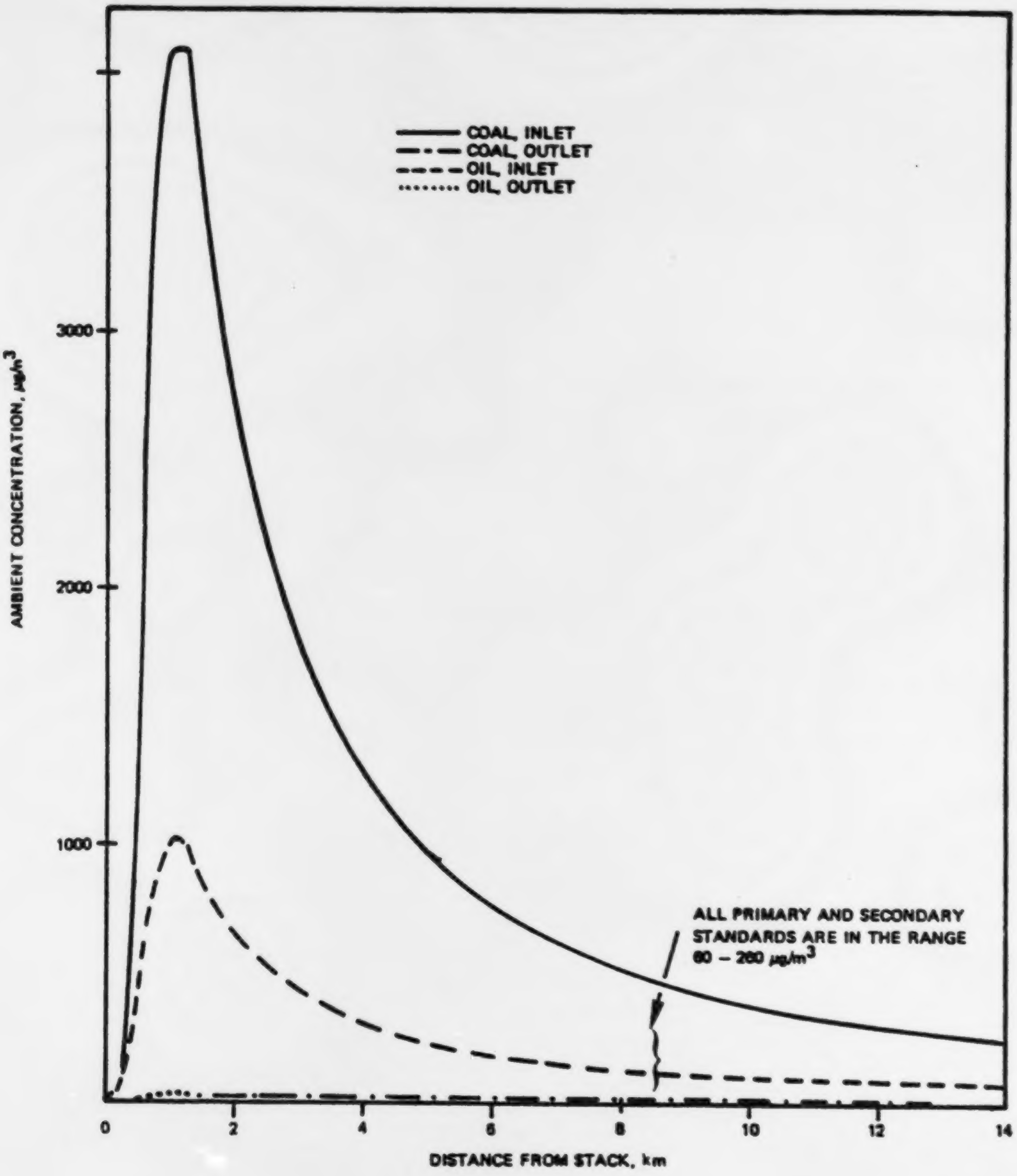


Figure 4-8. Comparison of Particulate Air Quality Resulting from Coal and Oil Firing under Worst Case Weather Conditions (Tests 201-1 and 202-1)

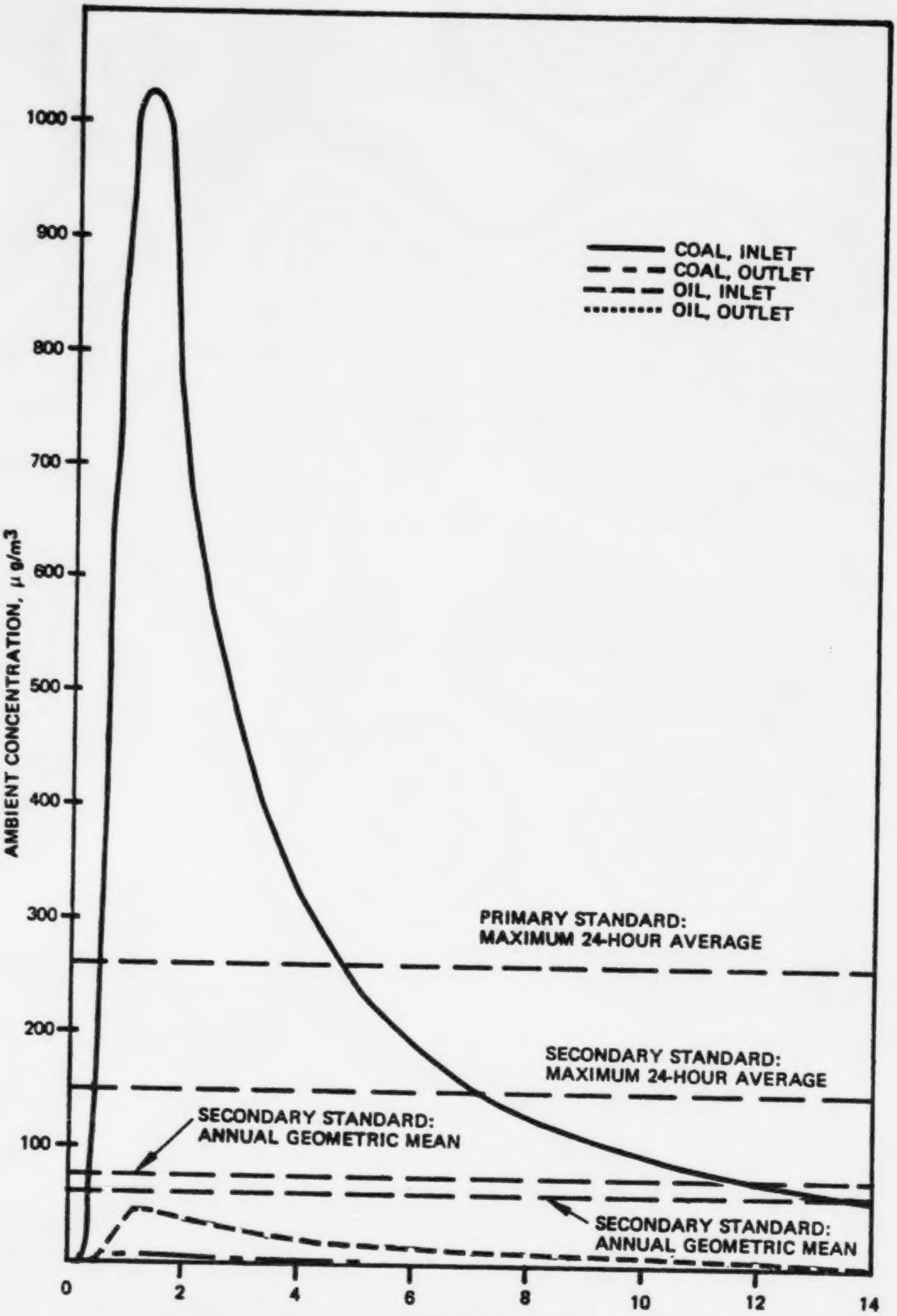


Figure 4-9. Comparison of Particulate Air Quality Resulting From Coal and Oil Firing Under Typical Weather Conditions (Tests 201-1 and 202-1)

TABLE 4-3. SUMMARY OF ULTIMATE FUEL ANALYSES (5 TEST AVERAGES)

Component	Coal		Oil	
	Weight %	σ[†]	Weight %	σ[†]
Moisture	7.15	0.86	~0	-
Carbon	72.10	1.07	86.28	0.39
Hydrogen	4.28	0.06	10.92	0.03
Nitrogen	0.92	0.07	0.36	0.06
Chlorine	0.12	0.02	N.A.[x]	-
Sulfur	1.64	0.23	1.96	0.08
Ash	9.90	0.85	0.02	0.004
Oxygen	3.89	0.23	0.46	0.40
kJ/kg	29,485	459	40,741‡	-

[†] σ = one standard deviation.

[x] N.A. = not analyzed.

*The heat content of the oil burned is nearly constant at this value; individual values were not available.

TABLE 4-7. SUMMARY OF CRITERIA POLLUTANT EMISSIONS - COAL FIRING

Test No.	ng/J (lb/MM Btu)							
	NO_x (as NO_2)	CO	SO_2	HC (as CH_4)	C_1 - C_6 Organics	C_7 - C_{16} Organics	Organics Higher Than C_{16}	Total Particulates
200 Inlet	417 (0.97)	20.7 (0.05)	1009 (2.35)	3.79 (0.01)	<5.49 (<0.01)	0.34 (0.00)	2.28 (0.01)	2361 (5.49)
200 Outlet	367 (0.85)	18.5 (0.04)	25.4 (0.06)	4.22 (0.01)	<5.49 (<0.01)	0.27 (0.00)	0.33 (0.00)	14.3 (0.03)
201-1 Inlet	491 (1.14)	16.5 (0.04)	1284 (2.99)	4.35 (0.01)	<5.65 (<0.01)	--	--	3122 (7.26)
201-1 Outlet	457 (1.06)	15.7 (0.04)	39.0 (0.09)	5.22 (0.01)	<5.65 (<0.01)	--	--	20.9 (0.05)
201-2 Inlet	455 (1.06)	17.7 (0.04)	1295 (3.01)	0.88 (0.00)	<5.75 (<0.01)	--	--	--
201-2 Outlet	358 (8.33)	15.9 (0.04)	35.5 (0.08)	1.33 (0.00)	<5.75 (<0.01)	--	--	--
201-3 Inlet	330 (0.77)	16.2 (0.04)	1028 (2.39)	10.9 (0.03)	<5.69 (<0.01)	--	--	--
201-3 Outlet	258 (0.60)	12.7 (0.03)	31.8 (0.07)	10.9 (0.03)	<5.69 (<0.01)	--	--	--
201-4 Inlet	409 (0.95)	8.56 (0.02)	942 (2.19)	8.95 (0.02)	<5.06 (<0.01)	--	--	3370 (7.84)
201-4 Outlet	420 (0.98)	8.95 (0.02)	49.7 (0.12)	9.73 (0.02)	<5.06 (<0.01)	--	--	20.6 (0.05)
Average Inlet	421 (0.98)	15.9 (0.04)	1112 (2.59)	5.79 (0.01)	<5.53 (<0.01)	0.34 (0.00)	2.28 (0.01)	2951 (6.86)
Average Outlet	372 (0.87)	14.3 (0.03)	36.3 (0.08)	6.29 (0.01)	<5.53 (<0.01)	0.27 (0.00)	0.33 (0.00)	18.6 (0.04)

TABLE 4-8. SUMMARY OF CRITERIA POLLUTANT EMISSIONS - OIL FIRING

Test No.	ng/J (lb/MM Btu)							
	NO_x	CO	SO_2	HC[†] (as CH_4)	C_1 - C_6 Organics	C_7 - C_{16} Organics	Organics Higher Than C_{16}	Total Particulates
202-1 Inlet	175 (0.41)	5.08 (0.01)	938 (2.18)	2.84 (0.01)	<4.63 (< 0.01)	--	--	166 (0.39)
202-1 Outlet	166 (0.39)	4.70 (0.01)	32.1 (0.07)	3.20 (0.01)	<4.63 (< 0.01)	--	--	20.2 (0.05)
202-2 Inlet	175 (0.41)	5.30 (0.01)	1075 (2.50)	4.61 (0.01)	<4.79 (< 0.01)	--	--	--
202-2 Outlet	165 (0.38)	5.03 (0.01)	29.2 (0.07)	5.01 (0.01)	<4.79 (< 0.01)	--	--	--
202-3 Inlet	181 (0.42)	6.22 (0.01)	1085 (2.52)	1.71 (0.00)	<4.73 (< 0.01)	--	--	--
202-3 Outlet	177 (0.41)	5.92 (0.01)	26.7 (0.06)	1.98 (0.01)	<4.73 (< 0.01)	--	--	--
202-4 Inlet	141 (0.33)	5.30 (0.01)	874 (2.03)	0.82 (0.00)	<4.14 (< 0.01)	--	--	59.0 (0.14)
202-4 Outlet	138 (0.32)	5.60 (0.01)	19.2 (0.04)	0.76 (0.00)	<4.14 (< 0.01)	--	--	15.0 (0.03)
203 Inlet*	--	--	--	--	--	0.17 (0.00)	2.61 (0.01)	--
203 Outlet*	--	--	--	--	--	0.02 (0.00)	0.43 (0.00)	--
Average Inlet	168 (0.39)	5.47 (0.01)	993 (2.31)	2.49 (0.01)	<4.57 (< 0.01)	0.17 (0.00)	2.61 (0.01)	113 (0.26)
Average Outlet	161 (0.37)	5.31 (0.01)	26.8 (0.06)	2.74 (0.01)	<4.57 (< 0.01)	0.02 (0.00)	0.43 (0.00)	17.6 (0.04)

*Emission factors were computed assuming an O_2 concentration of 5.5%, the average concentration for test 202.

[†] Total hydrocarbons as determined by FID.

TABLE 4-10. SCRUBBER INLET AND OUTLET PARTICULATE SIZE DISTRIBUTION

Aerodynamic Diameter Size Range, Microns	Weight %			
	Coal Firing (Test 201-1)		Oil Firing (Test 202-1)	
	Scrubber Inlet	Scrubber Outlet	Scrubber Inlet	Scrubber Outlet
< 1	0.0017	62	20	83
1 - 3	0.041	30	1	12
3 - 10	2.24	7	74	5
> 10	97.7	1	5	0

TABLE 4-11. EMISSION RATES OF PARTICULATES

Aerodynamic Diameter Size Range, Microns	Coal Firing (Test 201-1)			Oil Firing (Test 202-1)		
	kg/hr		Removal Efficiency	kg/hr		Removal Efficiency
	Scrubber Inlet	Scrubber Outlet		Scrubber Inlet	Scrubber Outlet	
< 1	0.0055	1.30	<0	4.48	2.27	49.2
1 - 3	0.13	0.63	<0	0.22	0.33	<0
3 - 10	7.3	0.15	97.9	16.6	0.14	97.4
> 10	316.5	0.021	>99.9	1.12	0.00	100
Total	324.0	2.10	99.3	22.4	2.74	87.8

TABLE 4-13. SUMMARY OF SULFATE EMISSIONS DURING COAL AND OIL FIRING

	Emission Rate, ng/J			
	Coal - Test 201-1		Oil - Test 202-4	
	Scrubber Inlet	Scrubber Outlet	Scrubber Inlet	Scrubber Outlet
Water Soluble	16.0 (24%)	8.1 (97%)	12.9 (56%)	8.0 (88%)
Acid Soluble	51.2 (76%)	0.2 (3%)	10.0 (44%)	3.5 (12%)
Total	67.2	8.3	22.9	9.1

TABLE 4-18. DEPTH PROFILE ANALYSIS OF COAL PARTICULATE WITH CONCENTRATIONS EXPRESSED AS NORMALIZED ATOM PERCENT* - TEST 201-1

		O	Na	S	Si	Al	Fe	Cl	P	V	Ca	C	K
Inlet	Level II cyclone catch	57	4	11	6	7	2	2	1				
	Level II filter catch	56	2.4	11.5	14.1	8	1.4	1.5	1.2		2		
	Level II filter catch; 76 Å	54.2	2.1	4.0	17.9	12.6	2.1	1.3	2.2	1.0	2.7		
Outlet	Level II filter catch	45.7	5.5	13.2	7.1	2.2		1.2	1.1	0.7	1.3	14.9	7.1
	Level II filter catch; 75 Å	48	7.4	11.5	9.0	5.2	1.2	1.1	1.1		1.1	12.1	1.8
	Level II filter catch; 150 Å	48.3	9.1	10.0	10.1	7.7	1.2	1.2	1.2			10.0	1.2
	Level II filter catch; 300 Å	48.3	8.8	8.0	10.6	9.6	2.1	1.0	1.2	0.5		8.0	1.8
	Level II filter catch; 500 Å	47.9	7.3	6.7	10.8	13	1.7	1.2	1.1		1.2	8.1	1.1
	Level II filter catch; 700 Å	47	7.3	6.1	11.6	11.0	2.3	0.9	1.5	0.5	1.0	8.8	1.6

* The atom percent of the 12 elements presented here adds up to 100 percent. Other elements present in the cyclone and filter catches were not studied in ESCA. Hence, the atom percents in this table are normalized atom percents and not absolute atom percents.

TABLE 4-19. DEPTH PROFILE ANALYSIS OF OIL PARTICULATE WITH CONCENTRATIONS EXPRESSED AS NORMALIZED ATOM PERCENT* - TEST 202-4

	O	Na	S	Si	Al	Fe	Cl	P	V	Ca	C	K
Inlet												
Level II Cyclone Catch	38.5	3.2	12.9	2.6	2.3		1.4	0.6	1.2		37.4	
Level II Filter Catch	48.6	4.2	10.7	11.8	3.1		1.3	1.5	1.7		17.2	
Level II Filter Catch; 76Å	46.3	4.7	6.5	17.1	3.3	0.8	1.4	1.1	3.3	0.9	12.9	1.7
Outlet												
Level II Filter Catch	45.5	5.7	9.7	14.6	3.4	1.3	2.3	1.6	1.7		14.1	
Level II Filter Catch; 76Å	53.5	3.2	6.8	22.0	4.0		1.3	1.0	2.0		6.2	

* The atom percent of the twelve elements presented here adds up to 100 percent. Other elements present in the cyclone and filter catches were not studied in ESCA. Hence, the atom percents in this table are normalized atom percents and not absolute atom percents.

TABLE 4-20. MAJOR PARTICULATE COMPONENTS DETERMINED BY PLM ANALYSIS*

Component	Approximate Weight %			
	Scrubber Inlet		Scrubber Outlet	
	Coal	Oil	Coal	Oil
Ash†				
Fused	15-30	13-23	---	---
Unfused	50-65	1-4	---	---
Minerals				
Fe_2O_3	1-5	< 1	15-25	8-16
Fe_3O_4 (Magnetite)	10-15	< 1	---	---
SiO_2	< 2	---	---	---
$CaCO_3$	---	≤ 3	1-5	---
Oil Soot	10-20	43-57	25-40	2-8
Coke	< 2	---	---	---
$CaSO_3 \cdot 1/2\ H_2O$ and Unknown Sulfate	---	20-39	50-65	80-90

[*] Coal-fired samples were taken from test 201-1. Oil-fired samples were taken from test 202-4.

[†] This is primarily composed of iron-aluminum silicates.

TABLE 4-25. COMPARISON OF ORGANIC COMPOUNDS IDENTIFIED BY GC/MS IN THE FLUE GAS DURING COAL AND OIL FIRING

Compound	Emission Rate, ng/J							
	Coal Fired				Oil Fired			
	201-2		201-3		202-2		202-3	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Propionaldehyde	0.075	0.17	0.024	--	0.075	--	0.052	--
Nitromethane	--	--	--	--	--	--	0.023	--
Ethyl-n-butyl ether	0.88	0.66	0.400	0.66	0.64	--	0.37	--
Ethyl acetate	--	--	--	--	--	--	--	0.85
Hydrocarbon (C_6H_{14})	--	--	0.17	--	--	--	--	--
Chloropropanol	--	--	--	0.0017	--	--	--	--
4-methyl-3-pentene-2-one	--	--	--	--	--	0.21	0.13	0.01
Unidentified alcohol	--	0.0018	--	--	--	--	--	--
Octanol	--	--	--	--	--	--	0.017	--
Ketone (MW 138)	--	--	--	--	--	--	0.0074	--
Ketone (MW 140)	0.0017	--	0.003	--	0.0053	--	--	--
Phthalic anhydride	--	--	--	--	--	--	0.011	--
Amyl benzoate	--	--	--	--	--	0.0006	--	--
Glycerol triacetate	--	--	--	--	--	--	0.016	--
Methyl substituted aromatic	0.00075	--	--	--	--	--	--	--

ADDITIONAL DATA

TABLE 2. PARAMETERS SAMPLED FOR COAL AND OIL FIRING

Location	Parameter	Sampling Method	Analysis
1	FUEL (coal & oil)	Grab	
	C, H, N, S, ash, moisture, heating value		Ultimate (lab)
	Inorganics		Level II (lab)
2	COMBINED BLOWDOWN	Composite dipper	On-site HACH kit
	Alkalinity/acidity		
	pH		
	conductivity		
	hardness		
	TSS		
	nitrate		
	sulfate		
	sulfite		
	phosphate		
	ammonia		
	nitrogen		
	organics		Level 1 & 2 (lab)
3	FLYASH	Composite grab	
	inorganics		Level 1 & 2 (lab)
	organics		Level 1 & 2 (lab)
4&5	FLUE GAS (inlet & outlet)		
	CO	Continuous, Beckman Model 865	Direct reading
		Grab (bag)	GC (TCD) on site
	CO_2	Grab (bag)	GC (TCD) on site
	$NO/NO_2/NO_x$	Continuous, TECO Model 10A	Direct reading
	N_2,O_2	Grab (bag)	GC (TCD) on site
	SO_2	Continuous, TECO Model 41	Direct reading
	SO_2/SO_3 H_2SO_4,HCl, HF, particulate sulfate,	Goksoyr-Ross	Level 2 (lab)
	total hydrocarbons (as CH_4)	Continuous, Beckman Model 400	Direct reading
	C_1 - C_6 organics	Grab (bag)	GC (FID) on site
		SASS	Level 1 (lab)
	particulate & vapor	Method 5	Level 2 (lab)
	particulate sizing	Anderson impactor	Level 1
		SASS	Level 2
6	SCRUBBER CAKE	Composite grab	
	inorganics		Level 1 & 2 (lab)
	organics		Level 1 & 2 (lab)
7	BOILER & SCRUBBER MAKEUP WATER	Top grab	
	organics		Level 1 (lab)
	inorganics		Not required
8	SCRUBBER MAKEUP SOLIDS	Grab	Not required

TABLE 3. ANNUAL EMISSIONS

Pollutant		kg/year					
		Scrubber Inlet			Scrubber Outlet		
		Coal Firing	Oil Firing	Coal/Oil	Coal Firing	Oil Firing	Coal/Oil
Gaseous	NOx (as NO_2)	500,810	164,230	3.05	442,520	157,390	2.81
	SO_2	1,127,300	906,202	1.24	36,800	24,453	1.51
	SO_3	6,184	7,249	0.85	4,157	5,183	0.80
	$SO_4^=$	67,214	20,894	3.22	8,110	8,303	0.98
	CO	16,119	4,991	3.23	14,497	4,845	2.99
	Organics (as CH_4)	5,870	2,272	2.58	6,377	2,500	2.55
	C_1 - C_6[†]	<5,606	<4,164	--	<5,606	<4,164	--
	C_7 - C_{16}	345	155	2.22	274	18	15.2
	C_{16}+	2,311	2,381	0.97	335	392	0.85
	Total Particulates	2,991,760	53,832	55.6	18,856	13,686	1.38
	<1μ	--	--	--	11,691	11,359	1.03
	1 - 3μ	--	--	--	5,657	1,642	3.45
	3 - 10μ	--	--	--	1,320	634	1.93
	>10μ	--	--	--	188	0[‡]	--
		m^3/year					
Liquid	Blowdown/Waste Water	~76,000	~ 76,000	~ 1	~ 76,000	~76,000	~ 1
	Cooling Water	~86,000	~ 86,000	~ 1	86,000	~86,000	~ 1
Solid	Bottom Ash	~ 778,600	~ 7,600	~ 103	~ 778,600	~ 7,600	~103
	Fly Ash	~1,800,000	~ 15,000	~ 120	~1,800,000	~15,000	~120
	Scrubber Cake	0	0	--	8,054,100	3,011,000	2.67

[*] Assuming 100% load, 45 weeks per year (7,560 hrs/year).

[†] These values represent the detection limit of the instrument used.

[‡] These values represent oil firing particulate with a minimum of coal ash contamination.

TABLE 4-12. SO_2, SO_3, and $SO_4^=$ EMISSIONS FROM COAL AND OIL FIRING

Pollutant	Oil					Oil				
	Test	Scrubber Inlet ng/J	Scrubber Outlet ng/J	% of Fuel Sulfur Found in Flue Gas at Inlet	Removal Effi-ciency %	Test	Scrubber Inlet ng/J	Scrubber Outlet ng/J	% of Fuel Sulfur Found in Flue Gas at Inlet	Removal Effi-ciency %
SO_2	201-1	1280	37.8	92	97	202-1	940	32.2	92	97
	201-4	937	47.8	94	95	202-4	874	19.2	90	98
SO_3	201-1	7.2	4.9	0.4	33	202-1	7.5	5.3	0.6	29
	201-4	4.9	3.3	0.4	32	202-4	8.4	6.0	0.7	28
$SO_4^=$	201-1	66.3	8.0	3	88	202-4	22.9	9.1	1.6	60
Total	201-1			95		202-4			92	

TABLE 4-24. SUMMARY OF THE INFRARED ANALYSIS OF ORGANICS FROM OIL AND COAL COMBUSTION

Total Organics, mg/m^3	LC1			LC2*			LC3			LC4			LC5			LC6			LC7			Total		
	Coal	Oil	Blank	Coal	Oil	Blank	Coal	Oil	Blank	Coal	Oil	Blank*	Coal	Oil	Blank	Coal	Oil	Blank	Coal	Oil	Blank	Coal	Oil	Blank
	0.14	0.09	0.02				0.06	0.05	0.03	0.12	0.03	0.01	0.37	0.04	0.02	0.95	0.28	0.10	0.06	0.02		1.70	0.51	0.18
Category	Intensity																							
Aliphatic Hydrocarbons	XM	XM	XM				XM	XM	XM	Xm				Xm	Xm		Xm				Xm			
Aromatic Hydrocarbons	Xm	Xm	Xm				XM	XM	XM	XM	Xm		Xm	Xm	Xm		Xm				Xm			
Chlorinated Hydrocarbons																Om								
Silicones							Xm			Xm				Xm	Xm		Xm							
Heterocyclic Sulfur Compounds										Xm			Xm	Xm			Xm			Xm				
Thiocarbonyl Compounds										Xm														
Nitro Compounds										XM			Xm	OM	Om					Om	Om			
Ethers										XM														
Esters									Xm	XM	XM		XM	XM	XM	XM	XM	XM	XM	XM	Xm			
Amides																Xm			Om	OM	Om			
Alcohols																Xm			Xm					
Glycols																	XM	XM		XM	XM			
Phenols										Xm									OM					
Carboxylic Acids										Xm						XM	XM	XM	XM	XM	XM			
Sulfonic Acids																				XM				
Silicates									XM															

*Not Analyzed.

O = At least one species suspected present.
X = At least one species present.

M = Major Component.
m = Minor Component.

TABLE 1. INPUT DATA USED IN PLUME HEIGHT CALCULATIONS

	Coal	Oil
Stack Temperature (^{o}C)	51.7	55.6
Ambient Temperature (^{o}C)	20.0	20.0
Stack Velocity (m/s)	16.44	16.44
Stack Area (m^2)	0.245	0.245
Stack Height (m)	10.0	10.0
Wind Speed (m/s)	4.0	4.0

TABLE 2. PROCESS SAMPLES ANALYZED BY GC/MS

SAMPLE NUMBER	SAMPLE DESCRIPTION
201-2-1-S-KD	Coal-fired, Test #2, concentrated field extraction of 4 liters of scrubber water.
201-3-1-S-KD	Coal-fired, Test #3, concentrated field extraction of 4 liters of scrubber water.
202-2-1-S-KD	Oil-fired, Test #2, concentrated field extraction of 4 liters of scrubber water.
202-3-1-S-KD	Oil-fired, Test #3, concentrated field extraction of 4 liters of scrubber water.
202-2-1-S	Oil-fired, Test #2, unconcentrated field extraction of 4 liters of scrubber water.
202-3-1-S	Oil-fired, Test #3, unconcentrated field extraction of 4 liters of scrubber water.
201-2-1-B-S-KD	Coal-fired, Test #2, concentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.
201-3-1-B-S-KD	Coal-fired, Test #3, concentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.
202-2-1-B-S-KD	Oil-fired, Test #2, concentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.
202-3-1-B-S-KD	Oil-fired, Test #3, concentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.
201-2-1B-B-S-KD	Coal-fired, Test #2, concentrated lab base/neutral extraction blank.
201-2-1-B-S	Coal-fired, Test #2, unconcentrated lab base/neutral extraction of 4 liters of field extracted scrubber water.
201-2-1-B-S	Coal-fired, Test #3, unconcentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.

TABLE 2. (Continued)

202-2-1-B-S	Oil-fired, Test #2, unconcentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.
202-3-1-B-S	Oil-fired, Test #3, unconcentrated lab base/neutral extraction of 2 liters of field extracted scrubber water.
201-2-1B-B-S	Coal-fired, Test #2, unconcentrated lab base/neutral extraction blank.
201-2-1-A-S-KD	Coal-fired, Test #2, concentrated lab acid extraction of 2 liters of field extracted scrubber water.
201-3-1-A-S-KD	Coal-fired, Test #3, concentrated lab acid extraction of 2 liters of field extracted scrubber water.
202-2-1-A-S-KD	Oil-fired, Test #2, concentrated lab acid extraction of 2 liters of field extracted scrubber water.
202-3-1-A-S-KD	Oil-fired, Test #3, concentrated lab acid extraction of 2 liters of field extracted scrubber water.
201-2-1-1B-A-S-KD	Coal-fired, Test #2, concentrated lab acid extraction blank.
201-2-1-A-S	Coal-fired, Test #2, unconcentrated lab acid extraction of 2 liters of field extracted scrubber water.
201-3-1-A-S	Coal-fired, Test #3, unconcentrated lab acid extraction of 2 liters of field extracted scrubber water.
202-2-1-A-S	Oil-fired, Test #2, unconcentrated lab acid extraction of 2 liters of field extracted scrubber water.
202-3-1-A-S	Coal-fired, Test #2, unconcentrated lab acid extraction of 2 liters of field extracted scrubber water.
201-2-1B-A-S	Coal-fired, Test #2, unconcentrated lab acid extraction blank.
201-2-SC-S-KD	Coal-fired, Test #2, concentrated lab extraction of scrubber cake.
201-3-SC-S-KD	Coal-fired, Test #3, concentrated lab extraction of scrubber cake.
202-2-SC-S-KD	Oil-fired, Test #2, concentrated lab extraction of scrubber cake.
202-3-SC-S-KD	Oil-fired, Test #3, concentrated lab extraction of scrubber cake.

TABLE 2. (Continued)

201-3-FA-S-XD	Coal-fired, Test #3, concentrated lab extraction of fly ash.
201-2-SCB-S-KD	Coal-fired, Test #2, concentrated lab extraction blank.
201-2-SC-S	Coal-fired, Test #2, unconcentrated lab extraction of scrubber cake.
201-3-SC-S	Coal-fired, Test #3, unconcentrated lab extraction of scrubber cake.
202-2-SC-S	Oil-fired, Test #2, unconcentrated lab extraction of scrubber cake.
202-3-SC-S	Oil-fired, Test #3, unconcentrated lab extraction of scrubber cake.
201-3-FA-S	Coal-fired, Test #3, unconcentrated lab extraction of fly ash.
201-2-SCB-S	Coal-fired, Test #2, unconcentrated lab extraction blank.

TABLE 3. OVERALL SIZE DISTRIBUTION

Size Ranges	201-1-Flyash	201-1-I-Cyclone	202-4-I-Cyclone
<3.2μm	20.8%	39.6%	21.2%
3.2-6.4	21.3%	26.9%	28.1%
6.4-12.8	19.9%	17.0%	26.6%
12.8-19.2	17.6%	9.9%	11.3%
19.2-32.0	12.0%	5.2%	8.9%
32.0-48.0	5.1%	0.9%	2.5%
48.0-64.0	2.3%	0.5%	0.5%
64.0-96.0	0.5%	0.0	1.0%
96.0-128	0.5%	0.0	0.0
>128μm	0.0	0.0	0.0
Arithmetic Mean Diameter	13.4μm	6.63μm	10.4μm

Size Ranges	201-1-I-Filter	201-1-Scrubber Cake	202-4-Scrubber Cake
<1.0μm	19.6%	33.0%	37.7%
1.0-2.0	22.5%	20.9%	29.1%
2.0-3.0	16.7%	13.1%	11.2%
3.0-4.0	10.5%	10.2%	9.9%
4.0-6.0	12.0%	10.7%	7.2%
6.0-8.0	8.6%	5.3%	2.2%
8.0-10.0	4.3%	2.4%	0.4%
10.0-14.0	2.9%	2.4%	1.3%
14.0-20.0	1.0%	1.5%	2.2%
>20.0μm	0.0	0.5%	0.9%
Arithmetic Mean Diameter	3.32μm	2.99μm	2.78μm

TABLE 4. PLM ANALYSES RESULTS

COAL FIRED BOILER SAMPLES

Components	201-1-Flyash			201-1-I-Cyclone			201-1-I-Filter			201-1-Scrubber Cake			201-1-0-Filter
	A	B	C	A	B	C	A	B	C	A	B	C	A
Partially fused flyash	65-80%	30	5-140	55-7%	25	5-65	40-55%	12	5-40	55-70%	20	4-60	
Flyash	1-5%	4	1-20	10-20%	4	1-16	35-50%	2	<1-13	10-20%	5	1-15	
Oil soot	5-15%	25	2-100	10-20%	15	2-80	10-25%	8	1-40	10-20%	15	1-60	25-40%
Magnetite	10-20%	12	3-45	10-20%	12	3-25	<2%	5	2-14	1-5%	10	5-45	
Iron oxide	2-5%	15	1-40	1-5%	7	<1-50	<2%	5	1-18	<2%	3	1-21	15-25%
Coke	1-5%	40	5-160	<2%	60	6-100							
Quartz	<2%	12	5-60	<2%	20	5-40							
Calcite										<1%	6	1-10	1-5%
$CaSO_3 \cdot 1/2H_2O$										10-20%	6 (length)	3-21 (length)	50-65%
Unknown sulfate													

OIL FIRED BOILER SAMPLES

Components			201-4-I-Cyclone			202-4-I-Filter	202-4-Scrubber Cake			202-4-0-Filter
			A	B	C	A	A	B	C	A
Partially fused flyash			20-35%	20	6-40					
Flyash			1-5%	3	<1-15					
Oil soot			60-75%	20	<1-140	10-20%	1-5%	30	1-80	
Magnetite			<2%	12	3-50					
Iron oxides			<1%	8	3-35	15-30%				5-10%
Unknown sulfate			1-5%			45-60%				50-65%
$CaSO_3 \cdot 1/2H_2O$							95%+	30	2-80	
Calcite						1-5%				
Water droplets						15-30%				30-45%

Key: A - Estimated weight percent
B - Estimated modal diameter (μm)
C - Size range (μm)

TABLE 10. ATOM CONCENTRATION AT A DEPTH OF 1400 A FOR GAS PARTICULATE SAMPLES

Element	201-1-I-Cyclone	201-1-I-Filter	201-1-0-Filter	202-4-I-Cyclone	202-4-I-Filter	202-4-0-Filter*
Li	922 ppm	0.10%	770 ppm	0.11%	291 ppm	37 ppm
Na	1.05%	1.33%	22.84%	2.27%	9.57%	10.36%
Mg	0.92%	0.77%	1.34%	1.06%	4.51%	2.44%
Al	18.48%	19.28%	9.17%	11.7%	8.1%	5.04%
Si	18.74%	17.88%	10.42%	22.44%	12.3%	23.13%
K	3.23%	3.62%	2.55%	2.75%	3.32%	2.68%
Ca	1.59%	1.91%	2.17%	2.62%	3.75%	3.55%
Ti	0.88%	0.89%	0.15%	0.42%	0.26%	890 ppm
V	294 ppm	310 ppm	187 ppm	0.97%	3.06%	1.22%
Cr	322 ppm	279 ppm	141 ppm	760 ppm	670 ppm	203 ppm
Mn	304 ppm	314 ppm	140 ppm	251 ppm	759 ppm	298 ppm
Fe	4.82%	4.02%	1.21%	5.44%	4.87%	1.42%
Sr	752 ppm	784 ppm	119 ppm	758 ppm	445 ppm	99 ppm
Ba	232 ppm	268 ppm	42 ppm	449 ppm	516 ppm	42 ppm

*Concentrations at 1200 Å depth.

TABLE 13. ELEMENTS SHOWING POSITIVE ENRICHMENT TRENDS

Coal	Oil
Sb, As, B, Cr, Mn, Ni, V, Zn, Se, Zr,	Ca, Mg, Sb, As, Cd, Cr, Co, Mn, Mo, Ni, V, Zn, Se

TABLE 14. FLUE GAS CONDITIONS ACROSS THE SCRUBBER

	SO_2 Concentration, ppm	Mass Loading, mg/m^3	Average Gas Flow Across the Scrubber, dscm/min
Coal			
201-1-I	1114	7180	89.3
201-1-0	33.8	48	
201-4-I	913	8660	
201-4-0	48.2	53	
Oil			
202-1-I	2969	452	
202-1-0	33.2	55	
202-4-T	1009	182	152.7
202-4-0	22.2	46	

TABLE 15. TOTAL SULFATE VALUES FROM THE MODIFIED METHOD 5 TRAIN

Sample	Sulfate Extraction Values (mg/m^3)		
	Hot H_2O Extraction	HNO_3 Extraction	Total
201-1 Coal Inlet			
Probe		0.2	--
Cyclone (>3μ)	<100	107.0	107.0
Filter	36.7	10.2	46.9
Inlet Total	36.7	117.4	154.1
201-1 Coal Outlet			
Probe	--	--	--
Filter	18.6	0.5	19.1
Outlet Total	18.6	0.5	19.1
202-4 Oil Inlet			
Probe	--	29.0	29.0
Cyclone (>3μ)	10.4	0.7	11.1
Filter	29.3	1.0	30.3
Inlet Total	39.7	30.7	70.4
202-4 Oil Outlet			
Probe	--	3.5	3.5
Filter	24.5	<0.33	24.5
Outlet Total	24.5	3.5	28.0

TABLE 16. FTIR BANDS, cm

Coal Filter	$NaHSO_4 \cdot H_2O$	Oil Filters	
Outlet		Inlet	Outlet
653 (w, sh)	650 (sh)		
773 (w)	775 (m)		
857 (s)	865 (s)	863 (s)	872 (s)
1038-1160 (s, b)	1040-1080 (b)	1047 (s)	1040 (s)
1235 (m)	1150-1350 (vb)	1155 (s)	1160 (s)
1660 (b)		1645 (b)	1645 (b)

TABLE 17. H_2SO_4 CONCENTRATION, mg/dscm (ppm)

Run	Inlet	Outlet	Scrubber Efficiency (%)
201-1	20.7* (5.09)*	14.3 (3.51)	31
201-4	15.5* (3.80)*	11.0 (2.69)	29
Average 201	18.1	12.7	30
202-1	25.2 (6.19)	17.9 (4.39)	29
202-4	31.6 (7.74)	22.7 (5.58)	28
Average 202	28.4	20.3	29

*Values corrected (+12%) for loss of H_2SO_4 to fly ash on filter.

TABLE 3-2. 1976 STEAM GENERATION AND FUEL CONSUMPTION DATA FOR BOILER NUMBER 4

Month	Total steam generated by unit	Steam generated by coal firing	Steam generated by oil firing	Coal Used to fire unit	Oil used to fire unit
	Pounds	Pounds	Pounds	Pounds/Month	Pounds/Month
JANUARY	63,191,120	NONE	63,191,120	NONE	479,630
FEBRUARY	56,731,849	NONE	56,731,849	NONE	426,064
MARCH	59,284,346	NONE	59,284,346	NONE	437,432
APRIL	65,082,129	NONE	65,082,129	NONE	481,852
MAY	54,663,247	NONE	54,663,247	NONE	408,942
JUNE	24,615,374	NONE	24,615,374	NONE	181,786
JULY	64,379,436	NONE	64,379,436	NONE	478,111
AUGUST	32,185,973	NONE	32,185,973	NONE	487,381
SEPTEMBER	17,249,137	NONE	17,249,137	NONE	125,047
OCTOBER	67,981,950	45,367,432	22,614,518	3,809,400	165,614
NOVEMBER	61,173,241	58,149,635	3,023,606	5,183,440	23,822
DECEMBER	70,591,100	67,407,612	3,183,488	5,733,500	23,403

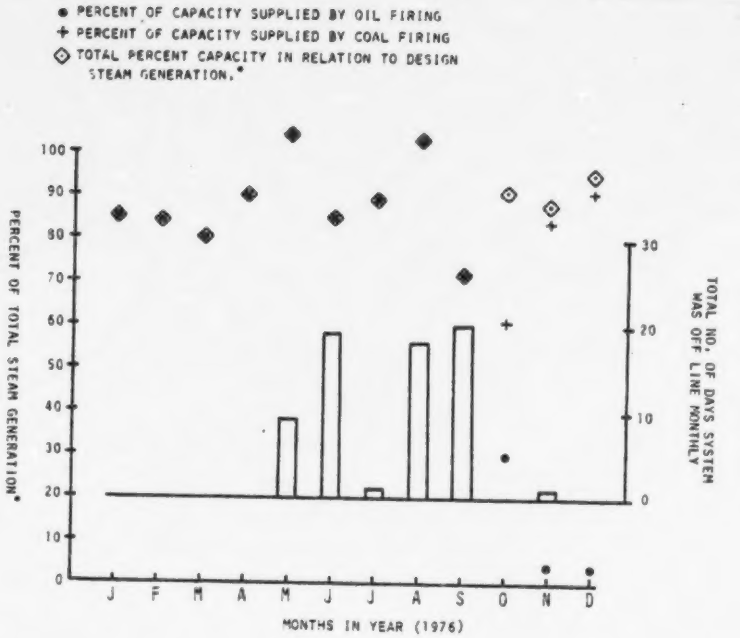
TABLE 3-3. 1977 STEAM GENERATION AND FUEL CONSUMPTION DATA FOR BOILER NUMBER 4

Month	Total steam generated by unit	Steam generated by coal firing	Steam generated by oil firing	Coal used to fire unit	Oil used to fire unit
	Pounds	Pounds	Pounds	Pounds/Month	Pounds/Month
JANUARY	64,436,850	54,930,366	9,506,484	4,831,180	70,554
FEBRUARY	63,707,500	55,383,646	8,403,854	4,892,600	17,053
MARCH	61,963,231	54,338,243	7,624,988	4,886,200	12,165
APRIL	61,350,362	58,033,817	3,316,545	4,875,820	24,567
MAY	69,071,439	53,378,917	15,692,522	4,710,700	118,251
JUNE	67,044,394	60,757,611	6,286,783	5,038,420	46,492
JULY	12,301,200	10,634,135	1,667,065	810,840	11,703
AUGUST	48,932,444	41,596,830	7,335,614	3,458,880	59,448
SEPTEMBER	65,526,263	60,504,449	5,021,814	5,488,900	37,758
OCTOBER	72,127,226	50,656,817	21,470,409	4,176,380	160,074
NOVEMBER	54,799,650	43,500,403	11,299,247	3,690,860	84,153
*DECEMBER	-	-	-	-	-

*At the time that this table was developed no information was available for December 1977.

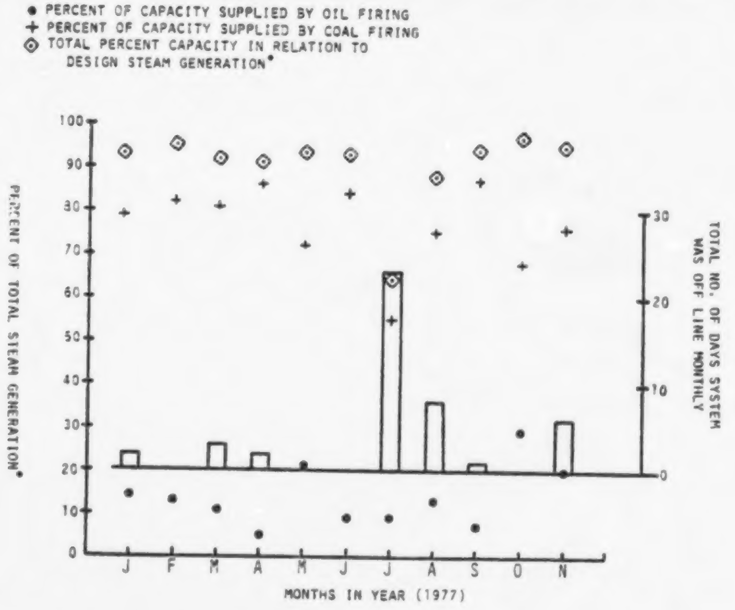
TABLE 3-4. NUMBER OF DAYS THAT BOILER WAS OFF-LINE FROM 1 JANUARY 1976 TO NOVEMBER 1977

Month	No. of days off-line	
	1976	1977
JANUARY	--	--
FEBRUARY	--	--
MARCH	--	3
APRIL	--	2
MAY	9	--
JUNE	19	--
JULY	1	23
AUGUST	18	8
SEPTEMBER	20	1
OCTOBER	--	--
NOVEMBER	1	6
DECEMBER	--	*
Total	68	45



*ASSUMING 100,000 LBS/HR AS 100% STEAM GENERATION

Figure 3-6. Comparison of fuel use and off-line schedule for 1976.



*ASSUMING 100,000 LBS/HR AS 100% STEAM GENERATION

Figure 3-7. Comparison of fuel use and off-line schedule for 1977.

TABLE 5-1. SUMMARY OF TEST CONDITIONS - COAL FIRING

Test No.	Steam Production Rate kg steam/hr	Steam Production Rate lbs. steam/hr	% of Maximum Load	Nominal Coal Feed Rate, kg/hr	% O_2 at Scrubber Inlet*	Estimated % Excess Air to Furnace†
200	39,700	87,500	87.5	3629	7.8	20
201-1	44,200	97,500	97.5	3629	8.2	20
201-2	43,100	95,000	95.0	3629	8.4	20
201-3	34,000	75,000	75.0	3175	8.3	20
201-4	40,800	90,000	90.0	3629	6.7	20

[*] Due to air leaks in ducting upstream of the scrubber inlet, tabulated O_2 values are not representative of combustion zone O_2 concentrations. Combustion zone O_2 concentrations normally range from 3 to 4% for this unit.

[†] % excess air is estimated to be 100 x $\frac{O_2 - CO/2}{0.264\ N_2 - (O_2 - CO/2)}$
where:
O_2 was assumed to be 3.5% and other species concentrations are computed from fuel analyses.

TABLE 5-2. FRACTION OF FLUE GAS PROCESSED BY THE SCRUBBER DURING COAL COMBUSTION

Test No.	Flow Rate at Scrubber Inlet, dscm/min*	% of Design Load	Total Flue Gas Flow Rate, dscm/min*	Fraction of Total Flue Gas Processed by the Scrubber
200	99	56	754	0.13
201-1	91	51	761	0.12
201-2	89	50	798	0.11
201-3	98	55	684	0.14
201-4	102	58	706	0.14
Average	96	54	741	0.13

[*] Dry standard cubic meters per minute (dscm/min).

TABLE 5-3. SUMMARY OF ULTIMATE COAL ANALYSES

	Test Number						
Weight %	200	201-1	201-2	201-3	201-4	Average	σ*
Moisture	8.44	7.37	6.54	7.18	6.23	7.15	0.86
Carbon	71.69	70.62	73.30	71.94	72.97	72.10	1.07
Hydrogen	4.33	4.18	4.31	4.27	4.30	4.28	0.06
Nitrogen	0.86	1.00	0.88	0.87	0.98	0.92	0.07
Chlorine	0.10	0.10	0.12	0.13	0.15	0.12	0.02
Sulfur	1.64	2.00	1.38	1.68	1.50	1.64	0.23
Ash	8.94	11.19	9.41	9.85	10.09	9.90	0.85
Oxygen	4.00	3.54	4.06	4.08	3.78	3.89	0.23
kJ/kg	29,263	28,872	29,997	29,419	29,874	29,485	459

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[*] σ = One standard deviation.

TABLE 5-9. SUMMARY OF CRITERIA POLLUTANT EMISSIONS-COAL FIRING

Test No.	ng/J (lb/MM Btu)							
	NO_x (as NO_2)	CO	SO_2	HC* (as CH_4)	C_1 - C_6 Organics	C_7 - C_{16} Organics	Organics Higher Than C_{16}	Total Particulates
200 Inlet	417 (0.97)	20.7 (0.05)	1009 (2.35)	3.79 (0.01)	<5.49 (<0.01)	0.34 (0.00)	2.28 (0.01)	2361 (5.49)
200 Outlet	367 (0.85)	18.5 (0.04)	25.4 (0.06)	4.22 (0.01)	<5.49 (<0.01)	0.27 (0.00)	0.33 (0.00)	14.3 (0.03)
201-1 Inlet	491 (1.14)	16.5 (0.04)	1284 (2.99)	4.35 (0.01)	<5.65 (<0.01)			3122 (7.26)
201-1 Outlet	457 (1.06)	15.7 (0.04)	39.0 (0.09)	5.22 (0.01)	<5.65 (<0.01)			20.9 (0.05)
201-2 Inlet	455 (1.06)	17.7 (0.04)	1295 (3.01)	0.88 (0.00)	<5.75 (<0.01)			
201-2 Outlet	358 (8.33)	15.9 (0.04)	35.5 (0.08)	1.33 (0.00)	<5.75 (<0.01)			
201-3 Inlet	330 (0.77)	16.2 (0.04)	1028 (2.39)	10.9 (0.03)	<5.69 (<0.01)			
201-3 Outlet	258 (0.60)	12.7 (0.03)	31.8 (0.07)	10.9 (0.03)	<5.69 (<0.01)			
201-4 Inlet	409 (0.95)	8.56 (0.02)	942 (2.19)	8.95 (0.02)	<5.06 (<0.01)			3370 (7.84)
201-4 Outlet	420 (0.98)	8.95 (0.02)	49.7 (0.12)	9.73 (0.02)	<5.06 (<0.01)			20.6 (0.05)
Average Inlet	421 (0.98)	15.9 (0.04)	1112 (2.59)	5.79 (0.01)	<5.53 (<0.01)	0.34 (0.00)	2.28 (0.01)	2951 (6.86)
Average Outlet	372 (0.87)	14.3 (0.03)	36.3 (0.08)	6.29 (0.01)	<5.53 (<0.01)	0.27 (0.00)	0.33 (0.00)	18.6 (0.04)

* Total hydrocarbons as determined by flame ionization detection (FID) analysis.

TABLE 5-10. SUMMARY OF CRITERIA POLLUTANT EMISSIONS - COAL FIRING

Test No.	kg/hr							
	NO_x (as NO_2)	CO	SO_2	HC (as CH_4)	C_1 - C_6 Organics	C_7 - C_{16} Organics	High Molecular Weight Organics	Total Particulates
200 Inlet	45	2.2	106	0.40	<0.59	0.04	0.25	248
200 Outlet	39	2.2	3.0	0.56	<0.59	0.001	0.004	1.7
201-1 Inlet	51	1.7	134	0.45	<0.60	--	--	324
201-1 Outlet	46	1.6	3.9	0.53	<0.60	--	--	2.1
201-2 Inlet	49	1.9	139	0.09	<0.62	--	--	--
201-2 Outlet	40	1.8	3.9	0.15	<0.62	--	--	--
201-3 Inlet	30	1.5	97	0.97	<0.53	--	--	--
201-3 Outlet	23	1.1	2.7	1.01	<0.53	--	--	--
201-4 Inlet	44	0.9	100	0.96	<0.55	--	--	362
201-4 Outlet	46	0.9	5.2	1.00	<0.55	--	--	2.1
Average Inlet	44	1.6	115	0.58	<0.57	0.04	0.25	311
Average Outlet	39	1.5	3.7	0.64	<0.57	0.001	0.004	2.0

TABLE 5-11. COMPARISON OF CRITERIA POLLUTANT EMISSIONS WITH EMISSION FACTORS FOR UNCONTROLLED BOILERS

Pollutant	ng/J (lb/MM Btu) Test Data Before Scrubber		ng/J (lb/MM Btu) Average Emission Factors for Uncontrolled Sources*	
NO_x (as NO_2 at full load)	491	(1.14)	343	(0.80)
CO	15.9	(0.04)	19	(0.04)
SO_2	1112	(2.59)	1189	(2.77)
Organics	5.79	(0.01)	5.72	(0.01)
Total Particulates	2951	(6.86)	3212	(7.47)

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[*] Factors are computed from AP-42 values using the national average bituminous coal higher heating value of 11,263 Btu/lb (Reference 6).

TABLE 5-12. SUMMARY OF NO_x REDUCTION DATA

Test No.	Average NO_x As NO_2 ng/J (ppm) Inlet	Average NO_x As NO_2 ng/J (ppm) Outlet	Average NO_x Removal by Integration Method* ng/J (ppm)	Average NO_x Removal by Integration Method* %
200	417 (515)	367 (456)	37 (46)	8.9
201-1	491 (591)	457 (551)	28 (34)	5.7
201-2	455 (539)	358 (424)	93 (110)	20.3
201-3	330 (395)	258 (309)	79 (95)	24.0
201-4	409 (547)	420 (564)	Not Significant	

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[*] The area between plots of inlet and outlet NO_x concentrations vs time was integrated and averaged with respect to time to yield average removals.

TABLE 5-13. APPROXIMATE SCRUBBER INLET PARTICULATE SIZE DISTRIBUTION FOR COAL FIRING (PLM) - TEST 201-1

Particle Diameter Size Range, Microns	Approximate Numerical %
<1	6
1 - 3	26
3 - 10	40
>10	28

TABLE 5-14. SCRUBBER INLET AND OUTLET PARTICULATE SIZE DISTRIBUTION BY WEIGHT FOR COAL FIRING - TEST 201-1

Aerodynamic Diameter Size, Range, Microns	Weight %	
	Scrubber Inlet	Scrubber Outlet
< 1	0.0017	62
1-3	0.041	30
3-10	2.24	7
>10	97.7	1

TABLE 5-15. EMISSION RATES OF PARTICULATES FOR A COAL-FIRED BOILER IN TEMPORAL UNITS - TEST 201-1

Aerodynamic Diameter Size Range, Microns	kg/hr Scrubber Inlet	kg/hr Scrubber Outlet	Removal Efficiency
<1	0.0055	1.30	<0
1-3	0.13	0.63	<0
3-10	7.3	0.15	97.9
>10	316.5	0.021	>99.9
Total	324.0	2.10	99.3

TABLE 5-17. SUMMARY OF SULFATE EMISSIONS DURING COAL FIRING - TEST 201-1

	mg/m^3 Inlet	mg/m^3 Outlet
Water soluble	36.7 (24%)	18.6 (97%)
Acid soluble	117.4 (76%)	0.5 (3 %)
Total	154.1	19.1

TABLE 5-21. MAJOR COAL PARTICULATE COMPONENTS - TEST 201-1

Component	Approximate weight % Inlet	Outlet
Ash*		
Fused	15-30	-
Unfused	50-65	-
Minerals		
Fe_2O_3	1-5	15-25
Fe_3O_4 (magnetite)	10-15	-
SiO_2	< 2	-
$CaCO_3$	-	1-5
Oil soot†	10-20	25-40
Coke	< 2	-
$CaSO_3 \cdot 1/2\ H_2O$ and Unknown sulfate	-	50-65

* Iron-aluminum silicates.

† See text for discussion.

TABLE 5-24. COMPARISON OF ORGANIC MEASUREMENT METHODS DURING COAL FIRING - TEST 200

Method	Organic Concentration mg/m^3 Inlet	Outlet	% Change
Total as CH_4 (FID)	9	11	Not Significant
C_1 - C_6 (GC)	≤ 12.7*	≤ 12.7*	-
C_7 - C_{16} (GC)	0.81	0.652	-20
C_{16} (Gravimetric)	5.4	0.788	-85

*These values represent the detection limit of the instrument used.

TABLE 5-25. SUMMARY OF THE INFRARED ANALYSIS OF ORGANICS PRODUCED DURING COAL COMBUSTION - TEST 200 INLET (NOT CORRECTED FOR BLANK)

	LC1*		LC2		LC3		LC4		LC5		LC6		LC7		Total	
Total Organics, mg/m^3	Sample	Blank	Sample	Blank	Sample	Blank	Sample	Blank	Sample	Blank	Sample	Blank	Sample	Blank	Sample	Blank
	0.14	0.02	--	-	0.06	0.03	0.12	0.01	0.37	0.02	0.95	0.10	0.06	-	1.70	0.18
Category	Intensity†															
Aliphatic Hydrocarbons	XM	XM			XM	XM	Xm			Xm				Xm		
Aromatic Hydrocarbons	XM	XM			XM	XM	XM		Xm	Xm				Xm		
Chlorinated Hydrocarbons											Om					
Silicones					Xm		Xm			Xm						
Heterocyclic Sulfur Compounds							Xm		Xm							
Thiocarbonyl Compounds							Xm									
Nitro Compounds			N/A				XM		Xm	Om				Om		
Ethers							XM									
Esthers							XM		XM	XM	XM	XM	XM	XM		
Amides						Xm					Xm		Om	Om		
Alcohols											Xm		Xm			
Glycols												XM		XM		
Phenols							Xm						OM			
Carboxylic Acids							Xm				XM	XM	XM	XM		
Silicates						Xm										

* LC fractionation was performed per standard Level 1 analytical procedures.

† O = At least one species suspected present
X = At least one species present
M = Material type accounts for 50% of the sample
m = Material type accounts for 10% of the sample

TABLE 5-26. ORGANIC COMPOUNDS IDENTIFIED IN THE FLUE GAS DURING COAL FIRING*

Compound Name	µg/m³ 201-2 In	µg/m³ 201-2 Out	µg/m³ 201-3 In	µg/m³ 201-3 Out
Propionaldehyde	170	380	54	-
Ethyl-n-butyl ether	2000	1500	910	1500
Hydrocarbon (C_6H_{14})	-	-	380	-
Chloropropanol	-	-	-	3.9
Unidentified Alcohol	-	4.0	-	-
Ketone (MW 140)	3.9	-	6.9	-
Methyl substituted aromatic	1.7	-	-	-

* As discussed in the text, these compounds are not considered to be directly associated with combustion.

TABLE 5-31. SOLID WASTE PRODUCTION RATES - COAL FIRING

Test	Bottom Ash kg/hr*	Bottom Ash µg/J	Scrubber Cake† kg/hr	Scrubber Cake† µg/J
200	~80	~0.75	1100	10.2
201-1	~80	~0.76	1100	10.5
201-2	~80	~0.73	1200	11.0
201-3	~80	~0.86	850	9.1
201-4	~80	~0.74	840	7.8

* 15 tons a week

† Scaled up to represent scrubbing of 100% of the flue gas for boiler number 4.

TABLE 5-32. SCRUBBER CAKE MASS BALANCE FOR COAL FIRING - TEST 201-1

Component	Contribution to Scrubber Cake kg/hr	Weight %
Fly Ash Removed by Scrubber	324	29.5
$CaSO_3 \cdot 1/2\ H_2O$ Formed from SO_2 Scrubbing and Na_2SO_3 Regeneration	262	23.8
$CaSO_4$, $CaCO_3$, Na_2SO_4, $Ca(OH)_2$, $NaHSO_3$ and Na_2SO_3 Losses (estimated)	10-85	0.9-7.7
Water	429-504	39-46
Total	1100	100

TABLE 5-36. ANNUAL EMISSIONS - COAL FIRING*

	Pollutant	Scrubber Inlet	Scrubber Outlet	% Difference
		kg/year	kg/year	
Gaseous	NO_x (as NO_2)	500,810	442,520	-12
	SO_2	1,127,300	36,800	-97
	SO_3	6,184	4,157	-33
	SO_4	67,214	8,110	-88
	CO	16,119	14,497	-10
	Organics (as CH_4)	5,870	6,377	+ 9
	$C_1 - C_6$ Organics	<5,606†	<5,606†	—
	$C_7 - C_{16}$ Organics	345	274	-21
	High Molecular Weight Organics	2,311	335	-86
	Total Particulates	2,991,700	18,856	-99
	0 — 1μ		11,691	—
	1 — 3μ		5,657	—
	3 — 10μ		1,320	—
	>10μ		188	—
		M^3/year	M^3/year	
Liquid	Blowdown/wastewater	~76,000	~76,000	0
	Cooling water	~86,000	~86,000	0
		kg/year	kg/year	
Solid	Bottom ash	~778,600	~778,600	0
	Fly ash (mechanical separator)‡	~1,800,000	~1,800,000	0
	Scrubber cake‡	0	8,054,100	—

* Assuming 100% load, 45 weeks/year (7,560 hours/year).

† These values represent the detection limit of the instrument used.

‡ Assuming that the mechanical separator is operating properly.

TABLE 6-1. SUMMARY OF TEST CONDITIONS - OIL FIRING

Test No.	Steam Production Rate kg Steam/hr	Steam Production Rate lb Steam/hr	% of Maximum Load	Nominal Oil Feed Rate, Gal/hr	% O_2 at Scrubber Inlet*	Estimated % Excess Air to Furnace+
202-1	45,400	100,000	100	900	5.8	21
202-2	45,400	100,000	100	900	6.3	21
202-3	44,200	97,500	97.5	880	6.1	21
202-4	42,200	93,000	93.0	805	4.0	21
203	31,800	70,000	70.0	600	Not Measured	21

*Due to air leaks in ducting upstream of the scrubber inlet, tabulated O_2 values are not representative of combustion zone O_2 concentrations. Combustion zone O_2 concentrations normally range from 3 to 4% for this unit.

+% excess air is estimated to be $100 \times \frac{O_2 - CO/2}{0.264\ N_2 - (O_2 - CO/2)}$, where O_2 was assumed to be 3.5% and other species concentrations were computed from fuel analyses.

TABLE 6-2. FRACTION OF FLUE GAS PROCESSED BY SCRUBBER DURING OIL COMBUSTION

Test No.	Flow Rate at Scrubber Inlet, dscm/min*	% of Design Load	Total Flue Gas Flow Rate, dscm/min*	Fraction Processed by the Scrubber
202-1	193	109.0	824	0.24
202-2	192	108.5	850	0.23
202-3	189	107.8	818	0.23
202-4	155	87.6	657	0.24
203	171	96.6	537	0.32
Average	180	101.9	737	0.25

*Dry standard cubic meters per minute (dscm/min).

TABLE 6-3. SUMMARY OF ULTIMATE OIL ANALYSES

Weight %	202-1	202-2	202-3	202-4	203	Average	σ*
Carbon	85.96	85.83	86.54	86.77	86.29	86.28	0.39
Hydrogen	10.95	10.88	10.95	10.92	10.89	10.92	0.03
Nitrogen	0.31	0.34	0.42	0.30	0.42	0.36	0.06
Sulfur	2.08	1.95	1.97	1.97	1.85	1.96	0.08
Ash	0.02	0.02	0.02	0.01	0.02	0.02	0.004
Oxygen	0.68	0.98	0.10	0.03	0.53	0.46	0.40
kJ/kg	-	-	-	-	-	40,741+	-

*σ = One standard deviation.

+The heat content of the oil burned is nearly constant at this value; individual values were not available.

TABLE 6-4. CONCENTRATION OF MAJOR TRACE ELEMENTS IN OIL (TEST 202-4)

Element	ppm in Fuel Oil	Typical Range[*]	Reference
Ca	5.50	No Data	
Mg	<0.4	No Data	
Sb	0.03[†]	0.002-0.8	1
As	2.0[‡]	0.0006-1.1	1
B	<0.15	No Data	
Cd	<3.5	No Data	
Cr	2.2	0.002-0.02	1
Co	<1.25	No Data	
Cu	1.40	No Data	
Fe	12.3	0.003-14	1,2
Pb	2.6[†]	No Data	
Mn	0.4[†]	0.001-6	1
Mo	2.9[†]	<0.1-1.5	1
Ni	16.0	14-68	3
V	36.5	15-590	3
Zn	3.0	No Data	
Se	0.7[†]	0.03-1	1
Sr	0.23	No Data	
Al	3.5	No Data	
Zr	<0.05	No Data	
Be	<0.05[**]	No Data	
Hg	0.09[††]	0.02-30	1

---

[*] Except for V and Ni, these ranges are for U.S. and foreign crude oils. Ranges of V and Ni concentrations are for fuel oils.

[†] Values were calculated from concentrations at the scrubber inlet when ICPOES analysis provided upper limit data only.

[‡] Arsenic concentration calculated from concentration at the scrubber inlet (see text).

[**] Performed by SSMS on a feed oil sample from test 203.

[††] Performed by cold vapor analysis on a feed oil sample from test 203.

TABLE 6-5. CRITERIA POLLUTANT EMISSIONS FOR AN OIL-FIRED INDUSTRIAL BOILER IN CONCENTRATION UNITS (5 TEST AVERAGE)

Pollutant	mg/Nm^3 (Grain/SCF) Before Scrubber		After Scrubber	
NO_x (as NO_2)	467	(0.20)	450	(0.20)
CO	15.3	(0.01)	14.9	(0.01)
SO_2	2763	(1.21)	74.3	(0.03)
Organics (as CH_4)	6.81	(0.00)	7.47	(0.00)
Total Particulates	317	(0.14)	50.7	(0.02)

TABLE 6-6. CRITERIA POLLUTANT EMISSIONS FOR AN OIL-FIRED INDUSTRIAL BOILER IN TEMPORAL UNITS (5 TEST AVERAGE)

Pollutant	kg/hr (lb/hr) Before Scrubber		After Scrubber	
NO_x (as NO_2)	22.2	(48.9)	21.4	(47.2)
CO	0.71	(1.58)	0.69	(1.52)
SO_2	130.7	(288)	3.55	(7.83)
Organics (as CH_4)	0.34	(0.75)	0.36	(0.79)
Total Particulates	14.8	(32.5)	2.28	(5.03)

TABLE 6-7. CRITERIA POLLUTANT EMISSIONS FOR AN OIL-FIRED INDUSTRIAL BOILER IN THERMAL UNITS (5 TEST AVERAGE)

Pollutant	ng/J (lb/MM Btu) Before Scrubber		ng/J (lb/MM Btu) After Scrubber	
NO_x (as NO_2)	168	(0.39)	161	(0.37)
CO	5.47	(0.01)	5.31	(0.01)
SO_2	993	(2.31)	26.8	(0.06)
Organics (as CH_4)	2.49	(0.01)	2.74	(0.01)
Total Particulates	113	(0.26)	17.6	(0.04)

TABLE 6-8. CRITERIA POLLUTANT EMISSIONS FOR AN OIL-FIRED INDUSTRIAL BOILER IN PRODUCTION RATE UNITS (5 TEST AVERAGE)

Pollutant	mg/Kg Steam (lb/1000 lb. steam) Before Scrubber		mg/Kg Steam (lb/1000 lb. steam) After Scrubber	
NO_x (as NO_2)	499	(0.50)	482	(0.48)
CO	16.1	(0.02)	15.5	(0.01)
SO_2	2945	(2.95)	79.7	(0.08)
Organics (as CH_4)	7.62	(0.01)	7.99	(0.01)
Total Particulates	331	(0.33)	51.6	(0.05)

TABLE 6-10. SUMMARY OF CRITERIA POLLUTANT EMISSIONS - OIL FIRING

Test No.	kg/hr							
	NO_x	CO	SO_2	HC (as CH_4)	C_1 - C_6 Organics	C_7 - C_{16} Organics	Organics Higher Than C_{16}	Total Particulates
202-1 Inlet	23.7	0.69	128	0.39	< 0.63	--	--	22.4
202-1 Outlet	22.7	0.64	4.35	0.45	< 0.63	--	--	2.74
202-2 Inlet	24.0	0.71	146	0.61	< 0.64	--	--	--
202-2 Outlet	22.4	0.66	3.98	0.66	< 0.64	--	--	--
202-3 Inlet	24.1	0.83	143	0.25	< 0.62	--	--	--
202-3 Outlet	23.6	0.78	3.53	0.25	< 0.62	--	--	--
202-4 Inlet	16.9	0.63	106	0.12	< 0.50	--	--	7.13
202-4 Outlet	16.9	0.67	2.33	0.08	< 0.50	--	--	1.82
203 Inlet	--	--	--	--	--	0.02	0.25	--
203 Outlet	--	--	--	--	--	0.00	0.04	--
Average Inlet	22.2	0.71	131	0.34	< 0.60	0.02	0.25	14.8
Average Outlet	21.4	0.69	3.55	0.36	< 0.60	0.00	0.04	2.28

TABLE 6-12. PARTICULATE SIZE DISTRIBUTION BY WEIGHT - TEST 202-1

Aerodynamic Diameter Size Range, Microns	Weight % Scrubber Inlet	Weight % Scrubber Outlet
<1	20	83
1 - 3	1	12
3 - 10	74	5
>10	5	0

TABLE 6-13. EMISSION RATES OF PARTICULATES FOR AN OIL-FIRED BOILER IN TEMPORAL UNITS - TEST 202-1

Aerodynamic Diameter Size Range, Microns	kg/hr Scrubber Inlet	kg/hr Scrubber Outlet	Removal Efficiency
<1	4.48	2.27	49.2
1 - 3	0.22	0.33	<0
3 - 10	16.6	0.14	97.4
>10	1.12	0.00	100
Total	22.4	2.74	87.8

TABLE 6-14. SO_2, SO_3, AND $SO_4^=$ EMISSIONS FROM OIL FIRING

Pollutant	Concentration mg/m^3	Mass Emission Rate g/hr	Thermal Emission Rate ng/J	Production Emission Rate mg/kg steam	% of Fuel Sulfur Found in Flue Gas	Removal Efficiency %
SO_2						
202-1 Inlet	2582	127,500	940	2811	92	97
202-1 Outlet	88.5	4,371	32.2	96.4	3	
202-4 Inlet	2689.2	106,060	874	2514	90	98
202-4 Outlet	59.2	2,335	19.2	55.4	2	
SO_3						
202-1 Inlet	20.6	1,017	7.50	22.4	0.59	29
202-1 Outlet	14.6	721	5.31	15.9	0.42	
202-4 Inlet	25.8	1,018	8.39	24.1	0.69	28
202-4 Outlet	18.6	734	6.05	17.4	0.50	
$SO_4^=$						
202-4 Inlet	70.4	2,776	22.9	65.8	1.58	60
202-4 Outlet	28.0	1,140	9.10	26.2	0.63	
Total						
202-1 Inlet					93	
202-1 Outlet					3.6	
202-4 Inlet					93	
202-4 Outlet					3.1	

TABLE 6-15. SUMMARY OF SULFATE EMISSIONS DURING OIL-FIRING - TEST 202-4*

	mg/m^3	
	Inlet	Outlet
Water Soluble	39.7 (56%)	24.5 (88%)
Acid Soluble	30.7 (44%)	3.5 (12%)
Total	70.4	28.0

*See Appendix C, Table 15, for details.

TABLE 6-20. CHLORIDE, FLUORIDE, AND NITRATE EMISSIONS FROM OIL FIRING - TEST 202-4

	Inlet*		Outlet*		Removal Efficiency, %
	mg/m^3	ng/J	mg/m^3	ng/J	
Chloride (Cl^-)	0.46-0.47	0.15	0.22 -0.23	0.072-0.075	52
Fluoride (F^-)	0.054	0.017	0.006-0.008	0.002-0.003	89
Nitrate (NO_3^-)	0.24	0.076	0.102	0.033	57

*Mass as the ion.

TABLE 6-21. COMPARISON OF ORGANIC MEASUREMENT METHODS

Test	Method	Organic Concentration mg/m^3		% Change
		Inlet	Outlet	
202-1	Total as CH_4 (continuous FID)	8	9	Not Significant
202-1	C_1 - C_6 (GC on bag samples)	≤12.7	≤12.7	---
203	C_7 - C_{16} (GC on SASS train samples)	0.469	0.07*	85%
203	>C_{16} (Gravimetric on SASS train samples)	7.27	1.2*	83%

*The values for the XAD-2 resin fraction were calculated using data obtained from similar sampling trains on four oil-fired boilers.

TABLE 4-21. CHLORIDE, FLUORIDE, AND NITRATE EMISSIONS FROM COAL AND OIL FIRING

Fuel	Test	Cl^-			F^-			NO_3^-		
		Inlet ng/J	Outlet ng/J	Removal Efficiency, %	Inlet ng/J	Outlet ng/J	Removal Efficiency, %	Inlet ng/J	Outlet ng/J	Removal Efficiency, %
Coal	201-1	4.7	<0.004	>99	0.22	<0.03	>86	<0.48	<0.25	--
Oil	202-4	0.15	0.072-0.075	50-52	0.017	0.002-0.003	85-89	0.076	0.033	57

TABLE 4-23. COMPARISON OF ORGANIC DETERMINATIONS DURING COAL AND OIL FIRING

Method	Coal Fired				Oil Fired			
	Test	Inlet	Outlet	% Change	Test	Inlet	Outlet	% Change
Total as CH_4 (Continuous FID)	200	3.8	4.6	Not Significant	202-1	2.9	3.3	Not Significant
C_1 - C_6 (GC on Bag Samples)	200	≤5.4	≤5.4	---	202-1	≤4.6	≤4.6	---
C_7 - C_{16} (GC on SASS Train Samples)	200	0.34	0.27^*	-20	203	0.17	0.02^*	-85
$>C_{16}$ (Gravimetric on SASS Train Samples)	200	2.3	0.33^*	-85	203	2.6	0.43^*	-83

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* The values for the resin sample are calculated (see text).

TABLE 4-30. SUMMARY OF C_7 - C_{16} ORGANICS IN THE WASTE WATER

Carbon Number	mg/l Coal Firing	mg/l Oil Firing	Carbon Number	mg/l Coal Firing	mg/l Oil Firing
C_7	ND*	ND	C_{13}	ND	ND
C_8	ND	ND	C_{14}	0.1	< 0.1
C_9	ND	ND	C_{15}	0.1	< 0.1
C_{10}	0.1	< 0.1	C_{16}	ND	ND
C_{11}	ND	ND			
C_{12}	ND	ND	Total C_7 - C_{16}	0.4	< 0.3

*ND means none detected.

TABLE 4-31. SOLID WASTE PRODUCTION RATES

Test	Bottom Ash kg/hr	Bottom Ash μg/J	Scrubber Cake† kg/hr	Scrubber Cake† μg/J
		COAL FIRING		
200	~80*	~753	1100	10.2
201-1	~80	~763	1100	10.5
201-2	~80	~735	1200	11.0
201-3	~80	~857	850	9.1
201-4	~80	~738	840	7.8
		OIL FIRING		
202-1	< 1	< 7.4	400	2.9
202-2	< 1	< 7.4	550	4.1
202-3	< 1	< 7.6	380	2.9
202-4	< 1	< 8.3	Not Measured	
203	< 1	<11.1	Not Measured	

*15 tons per week

†Scaled up to represent scrubbing of 100% of the flue gas for boiler No. 4.

TABLE 4-32. ESTIMATED SCRUBBER CAKE MASS BALANCE

Component	Contribution to Scrubber Cake			
	kg/hr		Weight %	
	Coal*	Oil*	Coal*	Oil*
Fly Ash Removed by Scrubber	324	5	29	1
$CaSO_3 \cdot 1/2\ H_2O$ Formed from SO_2 Scrubbing and Na_2SO_3 Regeneration	262	210	24	47
$CaSO_4$, $CaCO_3$, Na_2SO_3, $Ca(OH)_2$ $NaHSO_4$ and Na_2SO_4 Losses (Estimated)	10-85	6-35	1-8	1-8
Water	429-504	193-222	39-46	44-50
Total	1,100	443†	100	100

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[*] Coal firing data are from test 201-1 and oil firing data are from test 202-4.

[†] Total cake production rate was estimated from the average of tests 202-1, 202-2 and 202-3.

TABLE 6-28. SOLID WASTE PRODUCTION RATES - OIL FIRING

Test	Bottom Ash		Scrubber Cake[*]	
	kg/hr	ng/J	kg/hr	μg/J
202-1	<1	< 7.4	400	2.9
202-2	<1	< 7.4	550	4.1
202-3	<1	< 7.6	380	2.9
202-4	<1	< 8.3	Not Measured	
203	<1	<11.1	Not Measured	

[*] Scaled up to represent 100% of the flue gas for boiler No. 4.

TABLE 6-29. ESTIMATED SCRUBBER CAKE MASS BALANCE FOR OIL FIRING - TEST 202-4

Component	Contribution to Scrubber Cake	
	kg/hr	Weight %
Fly Ash Removed by Scrubber	5	1
$CaSO_3 \cdot 1/2\ H_2O$ Formed from SO_2 Scrubbing and Na_2SO_3 Regeneration	210	47
$CaSO_4$, $CaCO_3$, Na_2SO_4, $Ca(OH)_2$ $NaHSO_3$ and Na_2SO_3 Losses (Estimated)	6 - 35	1 - 8
Water	193 - 222	44 - 50
Total	443[*]	100

[*] Total cake production rate was estimated from the average of tests 202-1, 202-2 and 202-3.

STUDY NUMBER 4

DATA SOURCE:	**AIR EMISSIONS FROM COMBUSTION OF SOLVENT REFINED COAL**
DATA STATUS:	EPA—600/7-79-004, January 1979
AUTHORS: CONTRACTOR:	Kenneth G. Budden and Subhash S. Patel Hittman Associates, Inc. 9190 Red Branch Road Columbia, Maryland 21045
PROJECT OFFICER:	William J. Rhodes Industrial Environmental Research Laboratory Office of Energy, Minerals, and Industry U.S. Environmental Protection Agency Research Triangle Park, NC 27711

AIR EMISSIONS FROM COMBUSTION OF SOLVENT REFINED COAL

A preliminary report (dated July 1977) on the use of solvent-refined coal in a utility boiler was summarized in an earlier data compilation.[3] This final report includes additional information on the industrial processes sampled plus additional analytical results for C_7-C_{16} organics; polynuclear aromatic hydrocarbons; infrared spectrometry and gravimetry for organics; atomic absorption analysis for Hg, As, and Sb; spark source mass spectrometry for inorganic elemental composition; and additional atomic absorption spectrometry for selected elements of interest. For the sake of clarity all process descriptions, analytical results, and conclusions are presented (or reiterated) herein.

SRC is a coal that has been cleaned or refined to remove high levels of sulfur and mineral matter so that burning of the coal will produce a cleaner effluent gas. This study involved the first attempt to burn SRC on a large scale in a conventional utility boiler.

This study of SRC involved three sampling runs:

I. Low-sulfur Kentucky coal (~1% sulfur), burned in an unmodified 22.5 MW pulverized coal boiler.

II. Low-sulfur Kentucky coal (~1% sulfur), burned in the same boiler with dual register burners.

III. SRC, produced at the Fort Lewis, Washington, pilot plant from Kentucky coal having 4% sulfur and 10-12% ash, burned in the same boiler with dual register burners and appropriate modifications.

Figure 4-1 (from the document) shows the sampling points for effluent gas sampling in this study. Gaseous grab samples, using Level 1 techniques, were employed for sampling and analysis for O_2, N_2, CO, CO_2, and SO_x. NO_x and SO_x were also monitored by continuous monitors, a thermal Electron NO_x analyzer, and a Theta Sensor SO_x monitor, located downstream from the precipitator. A

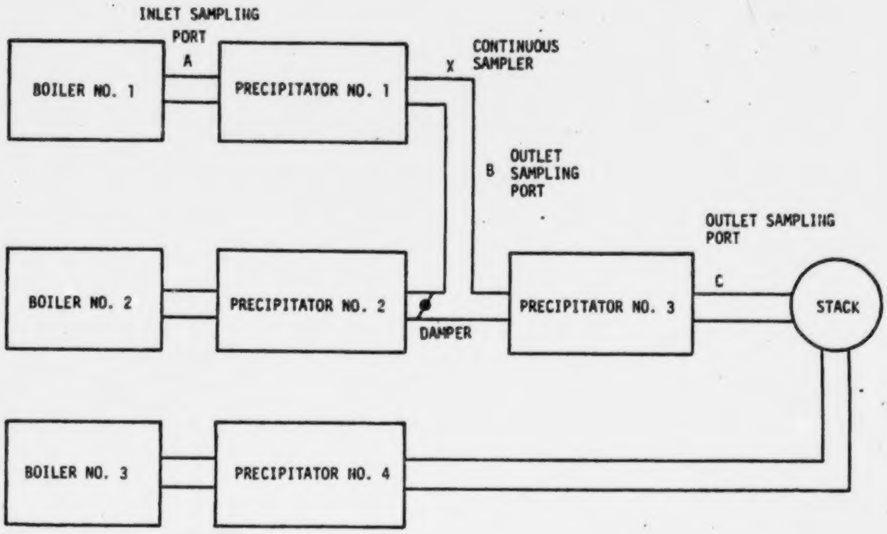
INLET SAMPLING PORT
A
BOILER NO. 1
PRECIPITATOR NO. 1
X
CONTINUOUS SAMPLER
B
OUTLET SAMPLING PORT
OUTLET SAMPLING PORT
C
BOILER NO. 2
PRECIPITATOR NO. 2
DAMPER
PRECIPITATOR NO. 3
STACK
BOILER NO. 3
PRECIPITATOR NO. 4

Figure 4-1. Diagram of sampling locations.

SASS train was used to sample effluent gases in runs II and III, and a Level 1 inorganic and organic analysis protocol was performed on the SASS train samples. Solid grab samples of coal and SRC from runs II and III were collected for Level 1 inorganic analysis. In addition to these Level 1 analyses, GC/MS analysis for polynuclear aromatic hydrocarbons was also run on the SASS organic samples, the SRC, and the coal.

Based on Level 1 results, two Level 2 SASS sampling runs and analyses were performed to further compare SRC and coal. Because nonvolatile hydrocarbons and polynuclear aromatic hydrocarbons had not been found in detectable quantities, only C_7-C_{12} hydrocarbon analysis was run on these samples. Atomic absorption analysis was run on 17 elements that had been shown to be present in significant quantities by Level 1 SSMS.

Significant results and conclusions of this study were:

1. SRC is a feasible replacement fuel for low-sulfur coal. No major operational problems were encountered.

2. SRC use produced significant reductions in emitted levels of SO_2, NO_x, and inorganics, as compared to low-sulfur coal. Emissions of SO_2 from SRC would meet the present NSPS requirement of 0.52 kg/GJ input but might not meet newly proposed and more stringent NSPS requirements. (See Table 4-1.) It should be noted that, although NO_x levels are well below NSPS requirements, these tests were conducted with abnormally high excess air, which lowers NO_x levels. Further tests at normal conditions are recommended.

3. Organic analysis showed no detectable levels of carcinogenic PAHs and levels of organics in the C_7-C_{12} hydrocarbon range that were not significantly different from low-sulfur coal.

It is significant to note that no sampling or analysis was performed on the refining solvents or wastes from recovery of refining solvents.

TABLE 4-1. SRC EMISSIONS

	Average emission level (Kg/GJ input)	Current NSPS requirement (Kg/GJ input)	Proposed new NSPS requirement (Kg/GJ input)
SO_2	0.46	0.52	26
NO_x	0.19	0.30	--

LEVEL 1

TABLE 4-2. SPARK SOURCE MASS SPECTROSCOPY
SRC SAMPLE
(μg/g)

U	1	Dy		Rh		Cr	3
Th		Tb		Ru		V	2
Bi		Gd		Mo	6	Ti	30
Pb	5	Eu		Nb	0.3	Sc	0.1
Tl		Sm		Zr	2	Ca	200
Hg		Nd		Y	0.9	K	20
Au		Pr		Sr	2	Cl	3
Pt	0.9	Ce	0.2	Rb	0.5	S	30
Ir		La	0.3	Br		P	9
Os		Ba	4	Se	0.6	Si	300
Re		Cs	0.5*	As	0.5	Al	10
W		I		Ge	0.1	Mg	40
Ta		Te		Ga	0.4	Na	30
Hf		Sb		Zn	8	F	40
Lu		Sn		Cu	4	B	10
Yb		In		Ni	5	Be	0.2
Tm		Cd		Co	0.2	Li	0.2
Er		Ag	0.2	Fe	30		
Ho		Pd		Mn	3		

*Elements designated as "≤" were identified, but because of their low concentrations, could not be quantified as accurately.

TABLE 4-3. SPARK SOURCE MASS SPECTROSCOPY
SASS TRAIN SAMPLE, JUNE 19, 1977
(μg/g)

U	19	Dy	2	Rh		Cr	371
Th	8	Tb	0.3	Ru		V	241
Bi		Gd	1	Mo	17	Ti	13,290
Pb	3	Eu	0.5	Nb	30	Sc	20
Tl	0.5	Sm	2	Zr	113	Ca	49,830
Hg		Nd	2	Y	42	K	798
Au		Pr	1	Sr	68	Cl	71
Pt	0.2	Ce	8	Rb	1	S	730
Ir		La	6	Br	30	P	666
Os		Ba	44	Se	2	Si	10,950
Re	0.1	Cs	0.2	As	43	Al	146
W	1	I	1	Ge	12	Mg	10,950
Ta	1	Te	0.2	Ga	29	Na	365
Hf	1	Sb	2	Zn	87	F	24
Lu	0.3	Sn	3	Cu	41	B	289
Yb	2	In		Ni	38	Be	10
Tm	0.2	Cd	1	Co	8	Li	5
Er	0.5	Ag	4	Fe	39,850		
Ho	1	Pd		Mn	160		

TABLE 4-4. SPARK SOURCE MASS SPECTROSCOPY
SASS TRAIN SAMPLE, JUNE 16, 1977
(μg/g)

U	34	Dy	7	Rh		Cr	70,415
Th	24	Tb	2	Ru		V	35,430
Bi		Gd	5	Mo	27	Ti	45,750
Pb	5	Eu	2	Nb	63	Sc	30
Tl	0.5	Sm	11	Zr	295	Ca	140,830
Hg		Nd	16	Y	118	K	35,140
Au		Pr	5	Sr	149	Cl	16
Pt	0.2	Ce	21	Rb	4	S	21,785
Ir		La	17	Br	3	P	36,200
Os		Ba	780	Se	10	Si	21,100
Re	0.2	Cs	2	As	57	Al	211
W	3	I	0.6	Ge	8	Mg	21,100
Ta	1	Te	0.4	Ga	28	Na	331
Hf	3	Sb	2	Zn	39	F	19
Lu	0.6	Sn	8	Cu	44	B	257
Yb	4	In		Ni	93	Be	14
Tm	0.5	Cd	1	Co	18	Li	5
Er	3	Ag	0.2	Fe	70,345		
Ho	4	Pd		Mn	311		

TABLE 4-5. ATOMIC ABSORPTION ANALYSIS SRC SASS TRAIN SAMPLE, JUNE 14, 1977 ($\mu g/m^3$)

Sample	As	Hg	Sb
SASS train	1.42	2.06	3.57

TABLE 4-6. ATOMIC ABSORPTION ANALYSIS COAL GRAB SAMPLES, MAY 25, 1977 ($\mu g/g$)

Sample	As	Hg	Sb
Sample I	2.9	0.3	1.7
Sample II	---	---	---

TABLE 4-7. ATOMIC ABSORPTION ANALYSIS COAL SASS TRAIN SAMPLE, MAY 25, 1977 ($\mu g/m^3$)

Sample	As	Hg	Sb
SASS train	2.32	0.57	4.55

TABLE 4-8. ATOMIC ABSORPTION ANALYSIS
SRC GRAB SAMPLES, JUNE 14, 1977
(μg/g)

Sample	As	Hg	Sb
Sample I	1.8	0.8	0.1
Sample II	---	---	---

TABLE 4-9. ATOMIC ABSORPTION ANALYSIS
COMBINED PARTICULATES AND XAD-2 RESIN
(ppm)

Sample	As	Hg	Sb
SRC	14	.045	ND

ND = None detected, antimony detection limit is 0.005 ppm

TABLE 4-10. ATOMIC ABSORPTION ANALYSIS
COMBINED PARTICULATES AND XAD-2 RESIN
($\mu g/m^3$)

Date	As	Hg	Sb
June 19, 1977	21.55	11.66	1.76

TABLE 4-11. ATOMIC ABSORPTION ANALYSIS
COMBINED PARTICULATES AND XAD-2 RESIN
($\mu g/m^3$)

Date	As	Hg	Sb
June 16, 1977	78.72	6.73	1.89

TABLE 4-12. ATOMIC ABSORPTION ANALYSIS
COAL AND SRC
($\mu g/m^3$)

Date	As	Hg	Sb
Coal	2.32	0.57	4.55
SRC	1.42	2.06	3.57

TABLE 4-13. FIXED GASES
GRAB SAMPLES, PHASE I (COAL COMBUSTION)
% (ppm)

Date	O_2	CO_2	CO	N_2
5/26	13.31 (133,100)	7.40 (74,000)	ND ND	79.29 (792,900)
5/31	14.24 (142,400)	7.50 (75,000)	ND ND	78.26 (782,600)
6/2	14.91 (149,100)	6.56 (65,600)	ND ND	78.53 (785,300)
5/25	15.73 (157,300)	5.51 (55,100)	ND ND	78.76 (787,600)
5/29	13.70 (137,000)	7.59 (75,900)	ND ND	78.71 (787,100)
5/30	12.60 (126,000)	7.35 (73,500)	ND ND	80.05 (800,000)

ND = None detected.

TABLE 4-14. FIXED GASES
% (ppm)

Date	O_2*	CO_2*	CO†	N_2*
5/24	NR NR	NR NR	NR NR	NR NR
5/27	13.78 (137,800)	6.65 (66,500)	ND ND	79.66 (796,600)
5/28	11.25 (112,500)	9.86 (98,600)	ND ND	78.89 (788,900)
6/5	12.14 (121,400)	9.31 (93,100)	ND ND	78.55 (785,500)
6/6	11.16 (111,600)	9.69 (96,900)	ND ND	79.15 (791,500)

ND = None detected.
NR = None reported.
*±2 percent of total concentration.
†40 ppm detectable limit.

TABLE 4-15. SULFUR GASES
GRAB SAMPLES, PHASE III - COAL COMBUSTION
(ppm)

Date	SO_x*	SO_x†
5/26	254	260
5/31	329	360
6/2	174	200
5/25	413	500
5/29	209	220
5/30	413	400
5/24	---	745
5/27	311	330
5/28	381	330
6/5	214	200
6/6	210	180

*±2 percent of total concentration.

†±10 ppm.

TABLE 4-16. NITROGEN OXIDE GASES
GRAB SAMPLES, PHASE II - COAL COMBUSTION
(ppm)

Date	NO_x*
5/26	110
5/31	110
6/2	100
5/25	170
5/29	160
5/30	150
5/24	225
5/27	215
5/28	220
6/5	170
6/6	110

*±10 ppm.

TABLE 4-17. GC ANALYSIS, C_1-C_6 GRAB SAMPLES, PHASE III - COAL COMBUSTION

Date	C_1-C_6	Detectable limit
5/24	NR	NR
5/25	ND	5 ppm
5/26	ND	5 ppm
5/27	ND	5 ppm
5/28	ND	0.5 ppm
5/29	ND	0.5 ppm
5/30	ND	0.5 ppm
5/31	ND	0.5 ppm
6/2	ND	0.5 ppm
6/5	ND	0.5 ppm
6/6	ND	0.5 ppm

NR = None reported.
ND = None detected.

TABLE 4-18. FIXED GASES GRAB SAMPLES, PHASE III - SRC COMBUSTION % (ppm)

Date	O_2*	CO_2†	CO*	N_2*
6/15	14.97 (149,700)	5.88 (58,800)	ND ND	79.33 (793,300)
6/18	13.25 (132,500)	6.73 (67,300)	ND ND	80.02 (800,200)
6/19	14.00 (140,000)	6.26 (62,600)	ND ND	79.74 (797,400)
6/14	13.65 (136,500)	7.53 (75,300)	ND ND	78.82 (788,200)
6/20	NR NR	NR NR	NR NR	NR NR

ND = None detected.
NR = None reported.
*±2 percent of total concentration.
†40 ppm detectable limit.

TABLE 4-19. FIXED GASES
GRAB SAMPLES, PHASE II - SRC COMBUSTION
% (ppm)

Date	O_2*	CO_2†	CO*	N_2*
6/21	NR NR	NR NR	NR NR	NR NR
6/13	11.39 (113,900)	9.86 (98,600)	ND ND	78.75 (787,500)
6/16	10.62 (106,200)	9.12 (91,200)	ND ND	80.26 (802,600)
6/17	11.11 (111,100)	9.15 (91,500)	ND ND	79.74 (797,400)
6/22	11.20 (112,000)	9.25 (92,500)	ND ND	79.55 (795,500)

ND = None detected.
NR = None reported.
*±2 percent of total concentration.
†40 ppm detectable limit.

TABLE 4-20. FIXED GASES
GRAB SAMPLES, PHASE II - SRC COMBUSTION
% (ppm)

Date	O_2*	CO_2†	CO*	N_2†
6/23	10.75 (107,500)	8.90 (89,000)	ND ND	80.35 (803,500)
6/24	10.76 (107,600)	9.29 (92,900)	ND ND	79.95 (799,500)

ND = None detected.
NR = None reported.
*±2 percent of total concentration.
†40 ppm detectable limit.

TABLE 4-21. SULFUR GASES
GRAB SAMPLES, PHASE III - SRC COMBUSTION
(ppm)

Date	SO_x*	SO_x†
6/15	198	225
6/18	216	220
6/19	218	235
6/14	248	260
6/20	NR	NR
6/21	NR	NR
6/13	371	325
6/16	410	335
6/17	404	345
6/22	400	345
6/23	393	325
6/24	449	380

NR = None reported.

*±2 percent of total concentration.

†±10 ppm.

TABLE 4-22. NITROGEN OXIDE GASES GRAB SAMPLES, PHASE III - SRC COMBUSTION (ppm)

Date	NO_x*
6/15	125
6/18	120
6/19	125
6/14	160
6/20	NR
6/21	NR
6/13	190
6/16	190
6/17	190
6/22	200
6/23	220
6/24	260

NR = None reported
*± 10 ppm

TABLE 4-23. GC ANALYSIS, C_1-C_6
GRAB SAMPLES, PHASE III - SRC COMBUSTION

Date	C_1-C_6*
6/15	ND
6/18	ND
6/19	ND
6/14	ND
6/20	NR
6/21	NR
6/13	ND
6/16	ND
6/17	ND
6/22	ND
6/23	ND
6/24	ND

ND = None detected.
NR = None reported.
*0.5 ppm detectable limit. C_1, C_2, C_3, C_4, C_5, and C_6 were reported separately but results were the same as indicated above.

TABLE 4-24. GAS CHROMATOGRAPHY ANALYSIS
June 19, 1977

Gas	Range	Volatile weight, ppm (mg/m^3)	No. of peaks
GC7*	90 - 110	0†	
GC8	110 - 140	0.09	
GC9	140 - 160	0.05	
GC10	160 - 180	0.03	
GC11	180 - 200	0.09	
GC12	200 - 220	0.05	
GC13		0	
GC14		0.04	
GC15		0	
GC16		0	
GC17			

*Not usually included in TCO range, i.e., C_8-C_{18}.
†Zero values represent a detection limit of 0.007 mg.

TABLE 4-25. GAS CHROMATOGRAPHY ANALYSIS
June 16, 1977

Gas	Range	Volatile weight,ppm (mg/m^3)	No. of peaks
GC7*	90 - 110	0†	
GC8	110 - 140	0.12	
GC9	140 - 160	0	
GC10	160 - 180	0.20	
GC11	180 - 200	0.06	
GC12	200 - 220	0.03	
GC13		0	
GC14		0.004	
GC15		0	
GC16		0	
GC17			

*Not usually included in TCO range, i.e., C_8-C_{18}.
†Zero values represent a detection limit of 0.007 mg.

TABLE 4-26. GAS CHROMATOGRAPHY ANALYSIS
SRC - JUNE 14, 1977

Gas	Range	Volatile weight, ppm (mg/m^3)	No. of peaks
GC7*	90 - 110		NR
GC8	110 - 140	0.11	NR
GC9	140 - 160	0.30	NR
GC10	160 - 180	0.19	NR
GC11	180 - 200	0.84	NR
GC12	200 - 220	0.49	NR
GC13			
GC14			
GC15			
GC16			
GC17			

*Not usually included in TCO range, i.e., C_8-C_{18}.

TABLE 4-27. GAS CHROMATOGRAPHY ANALYSIS
COAL - MAY 25, 1977

Gas	Range	Volatile weight, ppm (mg/m^3)	No. of peaks
GC7*	90 - 110	0.58	NR
GC8	110 - 140	--	NR
GC9	140 - 160	0.34	NR
GC10	160 - 180	0.08	NR
GC11	180 - 200	0.52	NR
GC12	200 - 220	0.57	NR
GC13			
GC14			
GC15			
GC16			
GC17			

*Not usually included in TCO range, i.e., C_8-C_{16}.

TABLE 4-28. GAS CHROMATOGRAPHY ANALYSIS
COAL - MAY 25, 1977
($\mu g/m^3$)

Gas	Range	Volatile weight, ppm	No. of peaks
GC7*	90 - 110	0.58	NR
GC8	110 - 140	T	NR
GC9	140 - 160	0.34	NR
GC10	160 - 180	0.08	NR
GC11	180 - 200	0.52	NR
GC12	200 - 220	0.57	NR
GC13			
GC14			
GC15			
GC16			
GC17			

*Not usually included in TCO range, i.e., C_8-C_{16}.
T = Trace.

TABLE 4-29. GAS CHROMATOGRAPHY ANALYSIS
SRC - JUNE 14, 1977
($\mu g/m^3$)

Gas	Range	Volatile weight, ppm	No. of peaks
GC7*	90 - 110	ND	NR
GC8	110 - 140	0.11	NR
GC9	140 - 160	0.30	NR
GC10	160 - 180	0.19	NR
GC11	180 - 200	0.84	NR
GC12	200 - 220	0.49	NR
GC13			
GC14			
GC15			
GC16			
GC17			

*Not usually included in TCO range, i.e., C_8-C_{16}.
ND = None detected.
NR = None reported.

TABLE 4-30
IR REPORT

SAMPLE: XAD-2 Resin Blank, (analysis on nonvolatile residue of extract) June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	Trace	benzene derivatives (680 ppm)	

NR = not reported

TABLE 4-31
IR REPORT

SAMPLE: Probe rinse, (analysis on nonvolatile residue of extract) June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of benzoic acid and other carboxylic acids	
NR	NR	glycol	
NR	NR	phenolic resin (640 ppm)	

NR = not reported

TABLE 4-32
IR REPORT

SAMPLE: XAD-2 Module Condensate Extract plus Module Rinse, (analysis on nonvolatile extract of residue) June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	phthalic acid ester	
NR	NR	other carboxylic acid esters	
NR	NR	phenolic resin (1,600 ppm)	

NR = not reported

TABLE 4-33
IR REPORT

SAMPLE: XAD-2 Resin, (analysis on nonvolatile extract of residue) June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	aliphatic carboxylates	
NR	NR	glycol	
NR	Minor	benzene derivatives (1,100 ppm)	

NR = not reported

TABLE 4-34
IR REPORT

SAMPLE: Methylene Chloride Blank, (analysis on nonvolatile residue) June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of benzoic acid and other carboxylic acids	
NR	NR	phenolic resin (3,700 ppm)	

TABLE 4-35
IR REPORT

SAMPLE: Methanol Blank, (analysis on nonvolatile residue) June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	phthalic acid ester	
NR	NR	salt of carboxylic acid	
NR	NR	phenolic resin (500 ppm)	

NR = not reported

TABLE 4-36
IR REPORT

SAMPLE: Methylene Chloride-Methanol Blank (50%-50%). (analysis on nonvolatile residue)
June 16, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of benzoic acid and other carboxylic acids	
NR	NR	glycol	
NR	NR	phenolic resin (1,200 ppm)	

NR = not reported

IR REPORT

SAMPLE:

Wave Number (cm^{-1})	Intensity	Assignment	Comments

TABLE 4-37
IR REPORT

SAMPLE: Probe Rinse, (analysis on nonvolatile residue) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of benzoic acid and other carboxylic acids	
NR	NR	glycol	
NR	NR	phenolic resin (660 ppm)	

NR = not reported

TABLE 4-38
IR REPORT

SAMPLE: XAD-2, Module Condensate Extract Plus Module Rinse, (analysis on nonvolatile residue) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	Major	aliphatic carboxylates	
NR	Minor	phthalates	
NR	Minor	benzoates	
NR	Minor	phenolic resin (1,700 ppm)	

NR = not reported

TABLE 4-39
IR REPORT

SAMPLE: XAD-2 Resin, (analysis on nonvolatile residue of extract) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of aliphatic carboxylic acid and benzoic acid	
NR	NR	glycol	
NR	Trace	benzene derivatives (700 ppm)	

NR = not reported

TABLE 4-40
IR REPORT

SAMPLE: Methylene Chloride Blank, (analysis on nonvolatile residue of extract) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of benzoic acid and other carboxylic acids	
NR	NR	phenolic resin (3,700 ppm)	

NR = not reported

TABLE 4-41
IR REPORT

SAMPLE: Methanol Blank, (analysis on nonvolatile residue) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	phthalic acid ester	
NR	NR	salt of carboxylic acid	
NR	NR	phenolic resin (500 ppm)	

NR = not reported

TABLE 4-42
IR REPORT

SAMPLE: Methylene Chloride-Methanol Blank (50%-50%), (analysis on nonvolatile residue) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	NR	esters of benzoic acid and other carboxylic acids	
NR	NR	glycol	
NR	NR	phenolic resin (1,200 ppm)	

NR = not reported

TABLE 4-43
IR REPORT

SAMPLE: XAD-2 Resin Blank, (analysis on nonvolatile residue) June 19, 1977

Wave Number (cm^{-1})	Intensity	Assignment	Comments
NR	Trace	benzene derivatives (680 ppm)	

NR = not reported

IR REPORT

SAMPLE: ____________________

Wave Number (cm^{-1})	Intensity	Assignment	Comments

LEVEL 2

TABLE 17. AA ANALYSIS FOR INORGANICS

Constituent	Coal SASS train run May 25, 1977		SRC SASS train run June 14, 1977		Coal grab samples May 25, 1977		SRC grab samples June 14, 1977	
	μg*	μg/m^3	μg*	μg/m^3	Sample I μg/g**	Sample II μg/g**	Sample I μg/g**	Sample II μg/g**
Aluminum	24,016	809.98	6,150	215.03	5,223.0	4,506.0	60.0	95.0
Antimony	135	4.55	102	3.57	1.7	--	0.1	--
Arsenic	69	2.32	41	1.42	2.9	--	1.8	--
Barium	1,430	48.23	335	11.71	58.0	--	2.0	--
Boron	7	0.24	56	1.95	ND	--	0.2	0.5
Chromium	1,694	57.13	475	16.61	13.0	4.5	4.0	6.0
Copper	246	8.30	18	0.63	16.0	14.0	1.2	1.5
Lead	185	6.24	40	1.40	9.0	7.5	0.5	ND
Iron	37,624	1,268.94	22,869	799.62	3,352.0	2,503.0	187.0	250.0
Magnesium	4,096	138.15	1,656	57.90	340.0	370.0	8.0	12.0
Manganese	884	29.81	1,789	62.55	21.0	21.0	14.5	18.0
Mercury	17	0.57	59	2.06	0.3	--	0.8	--
Nickel	2,441	82.33	385	13.46	12.0	10.5	2.0	2.3
Thorium	236	7.96	31	1.08	4.7	4.2	5.0	3.7
Uranium	6	0.20	101	3.53	1.3	1.4	0.8	1.3
Vanadium	364	12.28	1,269	5.91	24.1	20.0	11.4	10.9
Zinc	382	12.88	258	9.02	12.5	50.0	6.5	7.5

ND - None Detected
* - Total amount of element detected in sample
** - Concentration of element per gram of sample

ADDITIONAL DATA

TABLE 1. PHASE II - COAL COMBUSTION TEST SAMPLING SCHEDULE

Date	Load Condition	SASS Train Sampling Location
May 24	Full	Outlet ESP #1
May 25	Medium	Outlet ESP #1
May 26	Low	Outlet ESP #1
May 27	Full	Outlet ESP #1
May 28	Full	Inlet ESP #1
May 29	Medium	Inlet ESP #1
May 30	Medium	Outlet ESP #1
May 31	Low	Outlet ESP #1
June 1	Low	Inlet ESP #1
June 5	Full	Outlet ESP #3
June 6	Full	Outlet ESP #3

TABLE 2. PHASE III - SRC COAL COMBUSTION TEST SAMPLING SCHEDULE

Date	Load Condition	SASS Train Sampling Location
June 13	Full	Outlet ESP #1
June 14	Medium	Outlet ESP #1
June 15	Low	Outlet ESP #1
June 16	Full	Outlet ESP #1
June 17	Full	Inlet ESP #1
June 18	Low	Inlet ESP #1
June 19	Low	Outlet ESP #1
June 20	Medium	Inlet ESP #1
June 21	Medium	Outlet ESP #1
June 22	Full	Outlet ESP #3
June 23	Full	Outlet ESP #3
June 24	"wide open"	Outlet ESP #1

TABLE 5. COMBUSTION TEST, PHASE II - COAL SAMPLES

Date	Proximate Analysis % Sulfur	% Nitrogen	Heating* Value, MJ/kg
5/26	0.64	1.38	7.144
5/31	1.05	1.81	7.043
6/2	NA	NA	NA
5/25	1.09	1.29	7.007
5/29	0.62	1.82	7.139
5/30	1.15	1.82	7.139
5/24	1.34	1.19	7.042
5/27	0.73	1.51	7.081
5/28	0.72	1.45	7.079
6/5	0.66	1.60	NA
6/6	0.64	1.81	7.143

NA - Not Available

*Moisture and Ash Free Basis

TABLE 6. COMBUSTION TEST, PHASE III - SRC SAMPLES

Date	Proximate Analysis % Sulfur	% Nitrogen	Heating* Value, MJ/kg
6/15	0.70	1.54	7.530
6/18	0.74	1.80	NA
6/19	0.66	1.82	7.496
6/14	0.72	1.62	7.525
6/13	0.73	2.02	7.459
6/16	0.73	1.77	7.464
6/17	0.72	1.47	7.546
6/22	0.70	1.37	7.485
6/23	0.64	1.37	7.431
6/24	0.66	1.71	7.418

NA - Not Available

*Moisture and Ash Free Basis

TABLE 7. PROCESS INFORMATION

Date: June 16, 1977	
Load:	21 MW
Fuel Flow:	8,063 kg SRC/hr (17,775 lb/hr)
Heating Value:	7.464 MJ/kg SRC (15,602 Btu/lb)
Stack Gas Temperature:	166°C (331°F)
Sample Volume:	28,46 m^3 (1,005 DSCF)
Precipitator:	#1
Sample Port:	B (Outlet #1)
Precipitator Efficiency:	16.89%
Gas Flow, ESP #1 Outlet:	3,620 m^3/minute (127,858 ACFM)
Date: June 19, 1977	
Load:	7.5 MW
Fuel Flow:	3,379 kg SRC/hr (7,450 lb/hr)
Heating Value:	7.496 MJ/kg SRC (15,668 Btu/lb)
Stack Gas Temperature:	147°C (296°F)
Sample Volume:	30.16 m^3 (1,065 DSCF)
Precipitator:	#1
Sample Port:	B (Outlet #1)
Precipitator Efficiency:	45.68%
Gas Flow, ESP #1 Outlet:	2,005 m^3/minute (70,793 ACFM)

TABLE 15. PROCESS INFORMATION

Date: May 25, 1977	
Load:	14 MW
Fuel Flow:	6,940 kg coal/hr (15,300 lb/hr)
Heating Value:	7.007 MJ/kg (14,648 Btu/lb)
Stack Gas Temperature:	147°C (296°F)
Sample Volume:	29.65 m^3 (1,047 DSCF)
Precipitator:	#1
Sample Port:	B (Outlet #1)
Precipitator Efficiency:	94.81%
Gas Flow, ESP #1 Outlet:	3,002 m^3/minute (105,997 ACFM)
Date: June 14, 1977	
Load:	14 MW
Fuel Flow:	5,460 kg SRC/hr (12,038 lb/hr)
Heating Value:	7.525 MJ/kg (15,729 Btu/lb)
Stack Gas Temperature:	144°C (291°F)
Sample Volume:	28.60 m^3 (1,010 DSCF)
Precipitator:	#1
Sample Port:	B (Outlet #1)
Precipitator Efficiency:	21.96%
Gas Flow, ESP #1 Outlet:	3,076 m^3/minute (108,632 ACFM)

TABLE 19. INORGANIC AIR EMISSIONS FOR COAL AND SRC

Constituent	Coal May 25, 1977 $\mu g/m^3$*	SRC June 14, 1977 $\mu g/m^3$*
Aluminum	809.98	215.03
Antimony	4.55	3.57
Arsenic	2.32	1.42
Barium	48.23	11.71
Boron	0.24	1.95
Chromium	57.13	16.61
Copper	8.30	0.63
Lead	6.24	1.40
Iron	1,268.94	799.62
Magnesium	138.15	57.60
Manganese	29.81	62.55
Mercury	0.57	2.06
Nickel	82.33	13.46
Thorium	7.96	1.08
Uranium	0.20	3.53
Vanadium	12.28	5.91
Zinc	12.88	9.02

*The concentrations are based on amount of a constituent detected in the total particulates collected.

TABLE 20. SO_2 AND NO_x EMISSIONS FOR COAL AND SRC

Load Condition	Coal					SRC					% Reduction	
	Date	SO_2*		NO_x*		Date	SO_2*		NO_x*		SO_2	NO_x
Low (7.5 MW)	5/26/77	0.645	(1.50)	0.198	(0.46)	6/15/77	0.520	(1.21)	0.201	(0.48)	19.33	-4.35
Low	5/31/77	1.023	(2.38)	0.224	(0.52)	6/18/77	0.452	(1.05)	0.176	(0.41)	55.88	21.15
Low	6/01/77	0.598	(1.39)	0.215	(0.50)	6/19/77	0.486	(1.13)	0.176	(0.41)	18.71	18.00
Average		0.757	(1.76)	0.211	(0.49)		0.486	(1.13)	0.185	(0.43)	35.80	12.24
Medium (14 MW)	5/25/77	0.800	(1.86)	0.194	(0.45)	6/14/77	0.439	(1.02)	0.194	(0.45)	45.16	0.00
Medium	5/29/77	0.791	(1.84)	0.215	(0.50)	6/20/77	0.477	(1.11)	0.211	(0.49)	39.67	2.00
Medium	5/30/77	0.791	(1.84)	0.215	(0.50)	6/21/77	0.447	(1.04)	0.194	(0.45)	43.48	10.00
Average		0.796	(1.85)	0.201	(0.48)		0.456	(1.06)	0.198	(0.46)	42.70	4.17
Full (21 MW)	5/24/77	1.002	(2.33)	0.215	(0.50)	6/13/77	0.426	(0.99)	0.176	(0.41)	57.51	18.00
Full	5/27/77	0.443	(1.03)	0.201	(0.48)	6/16/77	0.412	(0.97)	0.168	(0.39)	5.83	18.75
Full	5/28/77	0.456	(1.06)	0.220	(0.51)	6/17/77	0.434	(1.01)	0.172	(0.40)	4.72	21.57
Average			(1.47)	0.215	(0.50)			(0.99)	0.172	(0.40)	32.65	20.00
Total Average		0.727	1.69	0.211	0.49		0.426	(1.06)	0.185	(0.43)	37.28	12.24

*Values are in kg/GJ and (lb/10^6 Btu)

TABLE 21. COMPARISON OF SRC AIR EMISSIONS WITH MEG's

Constituent	Minimum Acute Toxicity Effluent		Ambient Level Goal		Elimination of Discharge	SRC
	Based on Health Effects*	Based on Ecological Effects*	Based on Health Effects*	Based on Ecological Effects*	Natural Background*	June 14, 1977*
Aluminum	5,200	---	12.6	---	---	215.03
Antimony	500	---	1.2	---	0.007	3.57
Arsenic	2	---	0.005	---	0.00005	1.42
Barium	500	---	1	---	0	11.71
Boron	3,100	---	74	---	---	1.95
Chromium	1	---	0.002	---	0.012-0.001	16.61
Copper	200	---	0.5	---	0.01-0.41	0.63
Iron	---	---	---	---	___	799.62
Lead	150	---	0.36	---	0.002-0.47	1.40
Magnesium	6,000	---	14	---	1.4-800	57.90
Manganese	5,000	---	12	---	0.005-0.047	62.55
Mercury	50	10	0.01	1	---	2.06
Nickel	15	---	0.035	---	0.0006-0.021	13.46
Thorium	---	---	---	---	---	1.08
Uranium	9	---	0.5	---	---	3.53
Vanadium	500	1	1.2	0.1	0.005-0.024	5.91
Zinc	4,000	---	9.5	---	0.013-0.2	9.02

* Values are in $\mu g/m^3$

--- Values have not yet been developed

STUDY NUMBER 5

DATA SOURCE: **CHARACTERIZATION OF COAL PILE DRAINAGE**

DATA STATUS: EPA—600/7-79-051, February 1979

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This document presents results of field studies on the chemical composition of coal-pile drainage at two TVA coal-fired steam plants. A large reserve (about 25-100 acres of coal, piled 8-12 meters high) is maintained as a safety factor for electric generation (see Figure 5-1 from the final report), and drainage from rainfall percolating through the coal is very acidic and mineral rich. Rainfall was measured at both plants; runoff was measured at one plant.

Laboratory studies were directed toward a procedure that could be used to predict the chemical composition of drainage from these coal storage piles without resorting to extensive field sampling programs or long-term leaching studies. An 18-kg sample of coal was separated into three size fractions and each fraction was subjected to proximate analysis, ultimate analysis, and sulfur forms analysis. Ashed subsamples were analyzed for SiO_2, Al_2O_3, Fe_2O_3, CaO, TiO, MgO, SO_3, Na_2O, K_2O, Mn, Pb, and Cu by atomic absorption (AAS) or emission spectrometry (ES).

The coal-pile drainage samples were analyzed for acidity (amount of standard $CaCO_3$ solution to bring pH to 7.0), pH, conductivity, Cl, SO_4, dissolved solids, suspended solids, Fe, Mn, SiO_2, Cu, Zn, Cr, Al, Ni, Ca, Mg, Pb, Hg, Ba, As, Cd, Se, Ti, Be, and Sb. Elemental analysis was by AAS or ES, as appropriate.

In addition to analysis of the coal-pile drainage, bench studies were conducted to determine the ability of fly-ash slurry to treat coal-pile drainage. Note that the laboratory-simulated leaching procedure, using a shaker and deionized water, did not produce a leachate equivalent to the field-collected coal-pile leachate.

According to the abstract of the final report,

> Results indicate that coal pile drainage is highly acidic with pH's of 2.2 to 3.1. Total suspended solids concentrations, generally low during base flow periods, increase dramatically during storm runoff to levels as high as 2300 mg/liter. Sulfate concentrations were also quite high: 1800 to 9600 mg/liter. Concentrations of Fe and Mn were both very high: 23 to 1800 and 1.8 to 45 mg/liter, respectively. Other substances with concentrations of note include Al, Zn, Hg, As, and Se. Characteristics of elutes from shaker-type laboratory studies, except for pH, do not reflect values from field drainage of the same stored coal. Treatment with alkaline fly ash slurries, using ash sluicing ratios commonly encountered, can effectively raise the final solution pH and remove a variety of metals from solution. It was also observed that about 73% of the total rainfall is direct runoff.

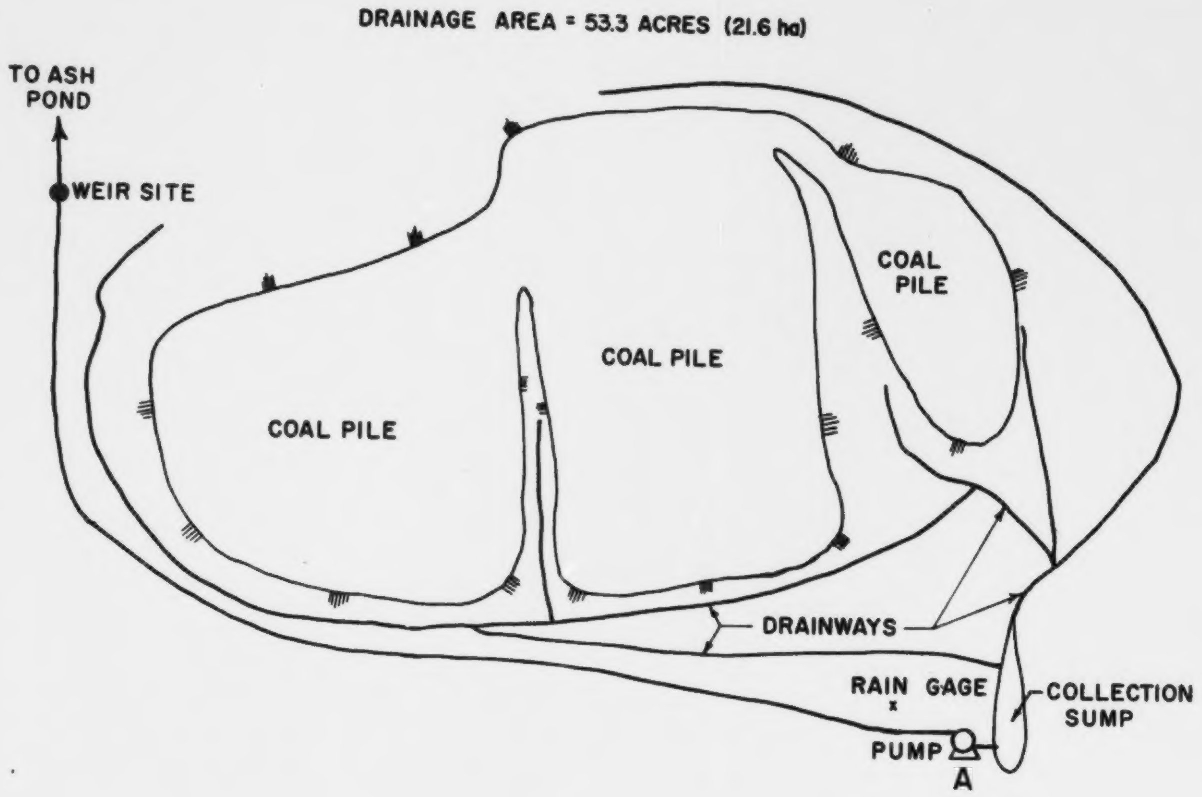

DRAINAGE AREA = 53.3 ACRES (21.6 ha)
TO ASH POND
WEIR SITE
COAL PILE
COAL PILE
COAL PILE
DRAINWAYS
RAIN GAGE
x
COLLECTION SUMP
PUMP
A

Figure 5-1. Coal pile and drainage collection system, plant J.

LEVEL 1

TABLE 5-1. FIELD WATER ANALYSIS, PLANT J, MARCH 9, 1976

Parameter	Assigned concentration
pH	2.9
Cond.	2,400 μmhos/cm
Suspended solids	550 mg/L
Dissolved solids	3,200 mg/L
Acidity	1,700 mg/L ($CaCO_3$)
Cl	0 mg/L
SO_4	2,600 mg/L

TABLE 5-2. FIELD WATER ANALYSIS, PLANT J, APRIL 7, 1976

Parameter	Assigned concentration
pH	2.6
Cond.	2,400 μmhos/cm
Suspended solids	110 mg/L
Dissolved solids	2,500 mg/L
Acidity	1,100 mg/L ($CaCO_3$)
Cl	20 mg/L
SO_4	1,800 mg/L

TABLE 5-3. FIELD WATER ANALYSIS, PLANT J, APRIL 13, 1976

Parameter	Assigned concentration
pH	2.8
Cond.	--
Suspended solids	--
Dissolved solids	--
Acidity	5,300 mg/L ($CaCO_3$)
Cl	--
SO_4	--

TABLE 5-4. FIELD WATER ANALYSIS, PLANT J, APRIL 29, 1976

Parameter	Assigned concentration
pH	2.5
Cond.	5,200 μmhos/cm
Suspended solids	150 mg/L
Dissolved solids	9,400 mg/L
Acidity	--
Cl	--
SO_4	4,500 mg/L

TABLE 5-5. FIELD WATER ANALYSIS, PLANT J, MAY 5, 1976

Parameter	Assigned concentration
pH	3.0
Cond.	4,600 µmhos/cm
Suspended solids	140 mg/L
Dissolved solids	6,800 mg/L
Acidity	2,200 mg/L ($CaCO_3$)
Cl	--
SO_4	3,100 mg/L

TABLE 5-6. FIELD WATER ANALYSIS, PLANT J, MAY 14, 1976

Parameter	Assigned concentration
pH	2.9
Cond.	--
Suspended solids	120 mg/L
Dissolved solids	7,500 mg/L
Acidity	2,400 mg/L ($CaCO_3$)
Cl	--
SO_4	--

TABLE 5-7. FIELD WATER ANALYSIS, PLANT J, MAY 26, 1976

Parameter	Assigned concentration
pH	3.0
Cond.	--
Suspended solids	8 mg/L
Dissolved solids	3,100 mg/L
Acidity	1,400 mg/L ($CaCO_3$)
Cl	--
SO_4	2,700 mg/L

TABLE 5-8. FIELD WATER ANALYSIS, PLANT J, JUNE 9, 1976

Parameter	Assigned concentration
pH	3.0
Cond.	4,000 µmhos/cm
Suspended solids	2,300 mg/L
Dissolved solids	5,900 mg/L
Acidity	300 mg/L ($CaCO_3$)
Cl	--
SO_4	4,500 mg/L

TABLE 5-9. FIELD WATER ANALYSIS, PLANT J, JUNE 17, 1976

Parameter	Assigned concentration
pH	2.8
Cond.	5,300 μmhos/cm
Suspended solids	210 mg/L
Dissolved solids	11,000 mg/L
Acidity	5,500 mg/L ($CaCO_3$)
Cl	--
SO_4	7,200 mg/L

TABLE 5-10. FIELD WATER ANALYSIS, PLANT J, JUNE 22, 1979

Parameter	Assigned concentration
pH	2.9
Cond.	4,200 μmhos/cm
Suspended solids	1,400 mg/L
Dissolved solids	7,400 mg/L
Acidity	3,700 mg/L ($CaCO_3$)
Cl	--
SO_4	4,600 mg/L

TABLE 5-11. FIELD WATER ANALYSIS, PLANT J, JULY 1, 1976

Parameter	Assigned concentration
pH	2.3
Cond.	5,600 μmhos/cm
Suspended solids	440 mg/L
Dissolved solids	13,000 mg/L
Acidity	6,100 mg/L ($CaCO_3$)
Cl	--
SO_4	7,400 mg/L

TABLE 5-12. FIELD WATER ANALYSIS, PLANT J, JULY 7, 1976

Parameter	Assigned concentration
pH	3.0
Cond.	--
Suspended solids	280 mg/L
Dissolved solids	3,500 mg/L
Acidity	1,700 mg/L ($CaCO_3$)
Cl	--
SO_4	1,800 mg/L

TABLE 5-13. FIELD WATER ANALYSIS, PLANT J, JULY 29, 1976

Parameter	Assigned concentration
pH	2.9
Cond.	5,400 μmhos/cm
Suspended solids	46 mg/L
Dissolved solids	12,000 mg/L
Acidity	5,900 mg/L ($CaCO_3$)
Cl	--
SO_4	7,800 mg/L

TABLE 5-14. FIELD WATER ANALYSIS, PLANT J, AUGUST 27, 1976

Parameter	Assigned concentration
pH	3.1
Cond.	5,900 μmhos/cm
Suspended solids	61 mg/L
Dissolved solids	16,000 mg/L
Acidity	7,100 mg/L ($CaCO_3$)
Cl	--
SO_4	7,600 mg/L

TABLE 5-15. FIELD WATER ANALYSIS, PLANT J, SEPTEMBER 1, 1976

Parameter	Assigned concentration
pH	2.6
Cond.	5,500 μmhos/cm
Suspended solids	170 mg/L
Dissolved solids	14,000 mg/L
Acidity	5,900 mg/L ($CaCo_3$)
Cl	--
SO_4	9,600 mg/L

TABLE 5-16. FIELD WATER ANALYSIS, PLANT J, SEPTEMBER 8, 1976

Parameter	Assigned concentration
pH	2.5
Cond.	3,700 μmhos/cm
Suspended solids	75 mg/L
Dissolved solids	7,600 mg/L
Acidity	3,600 mg/L ($CaCO_3$)
Cl	--
SO_4	3,700 mg/L

TABLE 5-17. FIELD WATER ANALYSIS, PLANT J, SEPTEMBER 29, 1976

Parameter	Assigned concentration
pH	3.0
Cond.	4,400 µmhos/cm
Suspended solids	480 mg/L
Dissolved solids	6,300 mg/L
Acidity	3,900 mg/L ($CaCO_3$)
Cl	--
SO_4	--

TABLE 5-18. FIELD WATER ANALYSIS, PLANT J, OCTOBER 6, 1976

Parameter	Assigned concentration
pH	3.0
Cond.	4,700 µmhos/cm
Suspended solids	1,900 mg/L
Dissolved solids	8,400 mg/L
Acidity	340 mg/L ($CaCO_3$)
Cl	--
SO_4	--

TABLE 5-19. FIELD WATER ANALYSIS, PLANT J, OCTOBER 13, 1976

Parameter	Assigned concentration
pH	2.3
Cond.	4,400 µmhos/cm
Suspended solids	39 mg/L
Dissolved solids	4,700 mg/L
Acidity	3,100 mg/L ($CaCO_3$)
Cl	--
SO_4	3,800 mg/L

TABLE 5-20. FIELD WATER ANALYSIS, PLANT J, OCTOBER 20, 1976

Parameter	Assigned concentration
pH	3.1
Cond.	4,300 µmhos/cm
Suspended solids	74 mg/L
Dissolved solids	7,700 mg/L
Acidity	3,800 mg/L ($CaCO_3$)
Cl	--
SO_4	8,000 mg/L

TABLE 5-21. FIELD WATER ANALYSIS, PLANT J, OCTOBER 27, 1976

Parameter	Assigned concentration
pH	2.9
Cond.	3,300 µmhos/cm
Suspended solids	63 mg/L
Dissolved solids	5,800 mg/L
Acidity	3,900 mg/L ($CaCO_3$)
Cl	--
SO_4	4,400 mg/L

TABLE 5-22. FIELD WATER ANALYSIS, PLANT E, NOVEMBER 3, 1976

Parameter	Assigned concentration
pH	3.1
Cond.	3,000 µmhos/cm
Suspended solids	180 mg/L
Dissolved solids	3,400 mg/L
Acidity	1,600 mg/L ($CaCO_3$)
Cl	19 mg/L
SO_4	2,900 mg/L

TABLE 5-23. FIELD WATER ANALYSIS, PLANT E, NOVEMBER 27, 1976

Parameter	Assigned concentration
pH	2.6
Cond.	3,000 µmhos/cm
Suspended solids	38 mg/L
Dissolved solids	3,100 mg/L
Acidity	1,300 mg/L ($CaCO_3$)
Cl	120 mg/L
SO_4	4,000 mg/L

TABLE 5-24. FIELD WATER ANALYSIS, PLANT E, DECEMBER 2, 1976

Parameter	Assigned concentration
pH	2.6
Cond.	4,500 µmhos/cm
Suspended solids	130 mg/L
Dissolved solids	5,000 mg/L
Acidity	2,100 mg/L ($CaCO_3$)
Cl	44 mg/L
SO_4	3,300 mg/L

TABLE 5-25. FIELD WATER ANALYSIS, PLANT E, DECEMBER 16, 1976

Parameter	Assigned concentration
pH	2.6
Cond.	3,400 μmhos/cm
Suspended solids	260 mg/L
Dissolved solids	3,900 mg/L
Acidity	1,300 mg/L ($CaCO_3$)
Cl	260 mg/L
SO_4	2,500 mg/L

TABLE 5-26. FIELD WATER ANALYSIS, PLANT E, DECEMBER 22, 1976

Parameter	Assigned concentration
pH	2.5
Cond.	3,000 μmhos/cm
Suspended solids	270 mg/L
Dissolved solids	2,900 mg/L
Acidity	860 mg/L ($CaCO_3$)
Cl	170 mg/L
SO_4	2,100 mg/L

TABLE 5-27. FIELD WATER ANALYSIS, PLANT E, DECEMBER 28, 1976

Parameter	Assigned concentration
pH	2.6
Cond.	3,100 μmhos/cm
Suspended solids	250 mg/L
Dissolved solids	3,100 mg/L
Acidity	1,000 mg/L ($CaCO_3$)
Cl	170 mg/L
SO_4	1,900 mg/L

TABLE 5-28. FIELD WATER ANALYSIS, PLANT E, MARCH 2, 1977

Parameter	Assigned concentration
pH	2.5
Cond.	3,300 μmhos/cm
Suspended solids	680 mg/L
Dissolved solids	3,300 mg/L
Acidity	920 mg/L ($CaCO_3$)
Cl	190 mg/L
SO_4	2,200 mg/L

TABLE 5-29. FIELD WATER ANALYSIS, PLANT E, MARCH 7, 1977

Parameter	Assigned concentration
pH	2.6
Cond.	2,700 μmhos/cm
Suspended solids	280 mg/L
Dissolved solids	2,300 mg/L
Acidity	700 mg/L ($CaCO_3$)
Cl	120 mg/L
SO_4	1,800 mg/L

TABLE 5-30. FIELD WATER ANALYSIS, PLANT E, MARCH 14, 1977

Parameter	Assigned concentration
pH	2.5
Cond.	2,600 μmhos/cm
Suspended solids	460 mg/L
Dissolved solids	270 mg/L
Acidity	1,200 mg/L ($CaCO_3$)
Cl	15 mg/L
SO_4	1,900 mg/L

TABLE 5-31. FIELD WATER ANALYSIS, PLANT E, APRIL 6, 1977

Parameter	Assigned concentration
pH	2.4
Cond.	6,400 μmhos/cm
Suspended solids	72 mg/L
Dissolved solids	8,200 mg/L
Acidity	2,500 mg/L ($CaCO_3$)
Cl	660 mg/L
SO_4	6,200 mg/L

TABLE 5-32. FIELD WATER ANALYSIS, PLANT E, APRIL 26, 1977

Parameter	Assigned concentration
pH	2.3
Cond.	2,200 μmhos/cm
Suspended solids	420 mg/L
Dissolved solids	5,100 mg/L
Acidity	4,800 mg/L ($CaCO_3$)
Cl	340 mg/L
SO_4	4,100 mg/L

TABLE 5-33. FIELD WATER ANALYSIS, PLANT E, JUNE 21, 1977

Parameter	Assigned concentration
pH	2.4
Cond.	6,000 µmhos/cm
Suspended solids	340 mg/L
Dissolved solids	6,300 mg/L
Acidity	1,500 mg/L ($CaCO_3$)
Cl	470 mg/L
SO_4	3,700 mg/L

ADDITIONAL DATA

TABLE C-1. WATER QUALITY DATA--PLANT 1

Date	Fe (mg/L)	Mn (mg/L)	SiO_2 (mg/L)	Cu (mg/L)	Zn (mg/L)	Cr (mg/L)	Al (mg/L)	Ni (mg/L)	Ca (mg/L)	Mg (mg/L)
3- 9-76	510	27.0	91	0.56	3.7	< 0.005	190	1.7	240	-
4- 7-76	300	8.9	62	0.42	2.3	0.010	66	0.7	190	64
4-13-76	1800	33.0	-	1.30	6.3	< 0.005	350	3.5	400	320
4-29-76	1100	31.0	310	0.84	5.4	< 0.005	300	2.3	31	270
5- 5-76	790	31.0	120	0.73	5.1	< 0.005	270	2.2	220	220
5-14-76	840	31.0	200	0.89	5.1	< 0.005	240	2.4	340	260
5-26-76	240	11.0	85	0.62	2.6	0.008	70	1.2	230	-
6- 9-76	580	23.0	210	1.10	6.6	< 0.005	240	2.5	320	160
6-17-76	760	39.0	390	1.40	9.2	-	370	3.9	330	340
6-22-76	620	34.0	220	1.10	5.6	-	310	2.7	320	210
7- 1-76	1700	32.0	180	1.10	16.6	-	350	3.9	370	350
7- 7-76	470	14.0	45	0.59	10.0	< 0.005	96	1.4	260	95
7-29-76	1800	33.0	240	1.10	8.1	< 0.005	440	4.0	280	380
8-27-76	1400	41.0	300	0.63	13.0	< 0.005	380	4.3	490	480
9- 1-76	1600	45.0	230	1.40	9.9	< 0.005	250	4.5	430	440
9- 8-76	790	28.0	92	0.60	4.6	0.010	430	2.2	300	17
9-29-76	1000	31.0	160	0.71	5.3	< 0.005	260	2.3	300	320
10- 6-76	750	27.0	160	0.58	4.1	0.009	220	1.8	350	27
10-13-76	780	26.0	140	0.70	4.0	0.008	180	1.6	320	150
10-20-76	1400	26.0	170	1.00	5.6	< 0.005	270	2.4	360	280
10-27-76	580	19.0	95	0.62	3.2	0.011	180	1.4	240	290

Date	Pb (mg/L)	Hg (mg/L)	Sn (mg/L)	As (mg/L)	Cd (mg/L)	Se (mg/L)	Tl (mg/L)	Be (mg/L)	Sb (mg/L)	Rainfall (cm)
3- 9-76	< 0.01	< 0.0002	-	0.010	< 0.001	0.030	< 1.0	-	-	2.62
4- 7-76	< 0.01	< 0.0002	-	-	< 0.001	< 0.002	< 1.0	-	-	0.08
4-13-76	< 0.01	< 0.0002	< 0.1	< 0.045	< 0.001	< 0.002	< 1.0	0.07	< 0.1	1.52
4-29-76	< 0.01	0.0002	< 0.1	0.150	< 0.001	0.002	< 1.0	0.06	< 0.1	1.47
5- 5-76	< 0.01	0.0025	0.1	0.110	< 0.001	0.006	< 1.0	0.05	< 0.1	2.16
5-14-76	< 0.01	< 0.0002	< 0.1	0.070	< 0.001	0.008	< 1.0	0.04	< 0.1	2.64
5-26-76	< 0.01	< 0.0002	0.2	0.040	< 0.001	0.006	< 1.0	0.03	0.6	0.25
6- 9-76	< 0.01	0.0004	< 0.1	0.360	< 0.001	0.005	< 1.0	0.03	1.1	6.07
6-17-76	< 0.01	0.0002	0.2	0.170	< 0.001	0.008	< 1.0	0.04	1.8	0.81
6-22-76	< 0.01	< 0.0002	< 0.2	0.310	< 0.001	0.011	< 1.0	0.03	1.4	9.96
7- 1-76	< 0.01	< 0.0002	< 0.3	0.006	< 0.001	0.008	< 1.0	0.05	1.1	7.04
7- 7-76	< 0.01	< 0.0002	< 0.1	0.080	< 0.001	-	< 1.0	0.04	0.1	7.98
7-29-76	< 0.01	< 0.0002	0.5	0.180	< 0.001	0.003	< 1.0	0.06	0.5	0.69
8-27-76	< 0.01	< 0.0002	0.4	0.005	< 0.001	0.002	< 1.0	0.06	1.0	-
9- 1-76	< 0.01	< 0.0002	0.2	0.200	< 0.001	0.001	< 1.0	0.07	0.6	2.26
9- 8-76	< 0.01	< 0.0002	0.2	0.084	< 0.001	0.004	< 1.0	0.03	0.6	5.54
9-29-76	< 0.01	0.0002	< 0.1	0.260	< 0.001	0.001	< 1.0	0.04	0.7	7.72
10- 6-76	< 0.01	0.0005	< 0.1	0.310	< 0.001	0.001	< 1.0	0.03	0.5	2.13
10-13-76	< 0.01	< 0.0002	< 0.1	0.180	< 0.001	0.001	< 1.0	0.03	0.7	4.45
10-20-76	< 0.01	0.0005	< 0.1	0.260	< 0.001	0.001	< 1.0	0.04	0.7	7.49
10-27-76	< 0.01	0.0007	< 0.1	0.200	< 0.001	0.002	< 1.0	0.03	0.5	9.14

TABLE C-2. WATER QUALITY DATA--PLANT E

Date	Fe (mg/L)	Mn (mg/L)	SiO_2 (mg/L)	Cu (mg/L)	Zn (mg/L)	Cr (mg/L)	Al (mg/L)	Ni (mg/L)	Ca (mg/L)	Mg (mg/L)
11- 3-76	470	3.2	28	0.20	3.0	< 0.011	56	0.40	210	46
11-27-76	340	2.5	45	0.23	2.0	0.005	38	0.28	230	38
12- 2-76	480	10.0	1	0.46	3.7	0.006	50	0.46	340	81
12-16-76	390	3.7	45	0.28	2.1	0.010	60	0.31	340	89
12-22-76	280	2.4	32	0.10	1.1	< 0.005	22	0.24	250	45
12-28-76	320	3.0	38	0.10	1.2	< 0.005	34	0.26	220	50
3- 2-77	300	3.2	27	0.07	1.3	< 0.005	39	0.15	320	51
3- 7-77	23	1.8	23	0.09	1.2	< 0.005	26	0.20	110	31
3-14-77	270	2.3	40	0.14	1.8	< 0.005	38	0.40	140	22
4- 6-77	590	12.0	45	0.26	3.7	< 0.005	20	0.46	400	130
4-26-77	480	4.6	41	0.12	2.8	< 0.005	92	0.49	720	78
6-21-77	310	5.0	-	0.12	5.1	0.009	-	0.40	520	120

Date	Pb (mg/L)	Hg (mg/L)	Ba (mg/L)	As (mg/L)	Cd (mg/L)	Se (mg/L)	Ti (mg/L)	Be (mg/L)	Sb (mg/L)	Rainfall (cm)
11- 3-76	< 0.01	0.0031	< 0.1	0.046	< 0.001	< 0.001	< 1.0	< 0.01	0.3	3.25
11-27-76	< 0.01	0.0072	< 0.1	0.018	< 0.001	< 0.001	< 1.0	< 0.01	0.3	8.28
12- 2-76	< 0.01	0.0032	< 0.1	0.006	0.003	< 0.001	< 1.0	< 0.01	< 0.1	4.24
12-16-76	< 0.01	-	< 0.1	-	0.002	-	< 1.0	-	< 0.1	1.47
12-22-76	< 0.01	< 0.0043	< 0.1	0.015	0.002	< 0.001	< 1.0	0.03	< 0.1	2.69
12-28-76	< 0.01	0.0035	< 0.1	-	0.003	-	< 1.0	< 0.01	< 0.1	2.18
3- 2-77	< 0.01	0.0020	< 0.1	0.027	0.001	0.001	< 1.0	< 0.01	< 0.1	1.85
3- 7-77	< 0.01	0.0014	< 0.1	0.014	0.001	0.002	< 1.0	< 0.01	< 0.1	9.42
3-14-77	< 0.01	0.0005	< 0.1	0.031	< 0.001	0.006	< 1.0	< 0.01	-	6.30
4- 6-77	< 0.01	0.0019	0.5	0.011	< 0.001	0.001	< 1.0	0.02	0.5	8.97
4-26-77	< 0.01	0.0030	< 0.1	0.019	< 0.001	< 0.001	< 1.0	0.01	0.4	5.16
6-21-77	< 0.01	0.0025	-	-	< 0.001	< 0.001	< 1.0	< 0.01	-	-

TABLE 4. CORRELATION MATRIX--PLANT E

	pH	Acid.	Cond.	Cl	SO_4	D.Sol	S.Sol	Fe	Mn	SiO_2	Cu	Zn	Cr	Al
pH	1.00													
Acid.	-.375	1.00												
Cond.	-.251	.039	1.00											
Cl	-.592	.398	.717	1.00										
SO_4	-.303	.605	.651	.738	1.00									
D.Sol	-.332	.510	.807	.840	.843	1.00								
S.Sol	-.305	-.028	-.319	-.096	-.475	-.341	1.00							
Fe	.010	.628	.415	.399	.722	.655	-.340	1.00						
Mn	-.248	.436	.766	.562	.760	.810	-.405	.715	1.00					
SiO_2	-.273	.136	-.070	.481	.273	.040	-.020	.122	-.220	1.00				
Cu	.194	.187	.360	-.053	.391	.351	-.609	.570	.668	-.378	1.00			
Zn	-.113	.435	.757	.512	.666	.743	-.283	.552	.651	-.184	.445	1.00		
Cr	.581	-.078	.177	-.021	-.025	.150	-.143	.227	-.049	-.014	.230	.441	1.00	
Al	-.013	.725	-.399	-.065	.091	.101	.211	.380	-.043	.038	.143	.341	.365	1.00
Ni	-.120	.740	.368	.309	.629	.507	-.322	.717	.628	.006	.513	.750	.218	.485
Ca	-.562	.819	.285	.630	.541	.676	.151	.535	.390	.186	.0[illegible]6	.549	.053	.692
Mg	-.395	.433	.846	.856	.733	.939	-.228	.603	.763	.122	.359	.784	.279	.148
Pb	0.00	0.00	-0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hg	.157	-.010	-.141	-.134	.176	.038	-.527	.158	-.140	.163	.209	-.081	-.022	.054
Ba	-.286	.237	.866	.842	.791	.755	-.364	.508	.746	.296	.210	.514	-.164	-.370
As	.645	-.153	-.432	-.403	-.329	-.443	.323	.003	-.504	.213	-.376	-.136	.707	.249
Cd	.087	-.156	0.00	-.254	-.289	-.024	-.255	.113	.186	-.406	.420	-.136	-.050	-.053
Se	-.065	-.221	-.304	-.362	-.415	-.640	.307	-.333	-.300	.189	-.171	-.278	-.218	-.129
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Be	-.197	-.109	.171	.281	.126	.165	-.198	.099	.146	.160	-.076	-.168	-.226	-.472
Sb	-.167	.678	.377	.647	.897	.714	-.355	.644	.466	.485	.095	.629	-.038	.211
RF1	-.225	.141	.240	.255	.474	.155	-.393	-.145	.226	.131	.054	.221	-.423	-.299
RF4	.086	-.302	-.084	.015	-.383	-.071	.335	-.013	-.224	.151	-.044	-.320	.455	.148

TABLE 4 (continued)

	Ni	Ca	Mg	Pb	Hg	Ba	As	Cd	Se	Ti	Be	Sb	RF1	RF4
Ni	1.00													
Ca	.532	1.00												
Mg	.533	.680	1.00											
Pb	0.00	0.00	0.00	1.00										
Hg	-.141	.035	-.112	0.00	1.00									
Ba	.367	.194	.738	0.00	-.211	1.00								
As	-.047	-.244	-.456	0.00	-.157	-.301	1.00							
Cd	-.036	-.058	.018	0.00	.200	-.221	-.514	1.00						
Se	.065	-.432	-.464	0.00	-.518	-.151	.275	-.187	1.00					
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00				
Be	-.105	-.055	.137	0.00	.142	.364	-.310	.120	-.188	0.00	1.00			
Sb	.666	.498	.527	0.00	.047	.669	.105	-.571	-.348	0.00	.038	1.00		
RF1	.209	-.154	.030	0.00	-.053	.458	-.379	-.510	.200	0.00	-.078	.526	1.00	
RF4	-.418	.054	.138	0.00	-.018	-.253	.284	.331	-.261	0.00	.037	-.529	-.781	1.00

TABLE 5. CORRELATION MATRIX--PLANT J

	pH	Acid.	Cond.	Cl	SO_4	D.Sol	S.Sol	Fe	Mn	SiO_2	Cu	Zn	Cr	Al	Ni	Ca
pH	1.00															
Acid.	-.229	1.00														
Cond.	-.053	.698	1.00													
Cl	-1.00	-1.00	0.00	1.00												
SO_4	-.029	.839	.781	-1.00	1.00											
D.Sol	-.114	.828	.895	-1.00	.878	1.00										
S.Sol	.250	-.462	-.097	-1.00	-.088	-.091	1.00									
Fe	-.178	.784	.775	-1.00	.867	.840	-.220	1.00								
Mn	-.089	.717	.794	-1.00	.767	.834	-.008	.677	1.00							
SiO_2	-.023	.616	.754	-1.00	.687	.738	.073	.503	.754	1.00						
Cu	-.116	.539	.581	-1.00	.764	.583	.133	.599	.642	.698	1.00					
Zn	-.145	.664	.761	-1.00	.621	.750	-.499	.602	.526	.453	.457	1.00				
Cr	-.342	-.279	-.502	1.00	-.398	-.351	-.042	-.502	-.526	-.522	-.551	-.584	1.00			
Al	-.119	.701	.653	-1.00	.633	.755	-.026	.690	.764	.640	.522	.470	-.296	1.00		
Ni	-.071	.832	.831	-1.00	.892	.934	-.046	.809	.870	.757	.766	.760	-.565	.770	1.00	
Ca	.157	.624	.409	-1.00	.633	.549	.144	.474	.515	.240	.396	.519	-.188	.352	.610	1.00
Mg	.113	.839	.700	0.00	.857	.762	-.350	.714	.709	.634	.566	.578	.565	.459	.800	.386
Pb	0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00
Hg	.258	-.204	-.023	0.00	-.178	-.093	-.022	-.107	0.00	-.186	-.133	-.162	-.049	-.028	-.139	-.186
Ba	-.037	.643	.613	0.00	.532	.679	-.226	.488	.384	.363	.183	.558	-.134	.574	.648	.303
As	.211	-.287	-.106	0.00	.188	-.092	.638	-.142	.011	.176	.218	-.298	.106	-.042	-.102	-.017
Cd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Se	.086	-.203	-.415	-1.00	-.317	-.274	.118	-.304	-.001	-.141	-.085	-.063	-.205	-.086	-.109	0.138
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Be	-.130	.688	.803	0.00	.623	.755	-.390	.814	.621	.482	.478	.501	-.631	.431	.721	.176
Sb	-.050	.295	.138	0.00	.400	.314	.306	-.071	.306	.514	.390	.337	.136	.294	.381	.368
RF1	.114	.069	-.134	-1.00	.013	-.085	.240	-.066	-.053	-.216	-.051	.189	.069	.021	-.098	.205
RF2	.138	-.483	-.309	0.00	-.372	-.394	.325	-.537	-.615	-.338	-.285	-.048	.422	-.517	-.394	-.141
RF3	-.108	.413	.102	0.00	.281	.257	-.117	.391	.475	.119	.244	.113	-.306	.434	.259	.198
RF4	-.175	-.290	-.510	1.00	-.352	-.372	-.141	-.323	-.526	-.308	-.363	-.301	.413	-.447	-.408	-.289
TSLS	-.073	.128	.043	-1.00	.352	.240	-.018	.083	.498	.234	.341	.055	-.292	.135	.345	.212

TABLE 5 (continued)

	Mg	Pb	Hg	Ba	As	Cd	Se	Tl	Be	Sb	RF1	RF2	RF3	RF4	TSLS
Mg	1.00														
Pb	-0.00	1.00													
Hg	-.087	0.00	1.00												
Ba	.516	0.00	-.242	1.00											
As	-.282	0.00	.047	-.304	1.00										
Cd	0.00	2.36	0.00	0.00	0.00	1.00									
Se	.001	0.00	-.036	.128	-.341	0.00	1.00								
Tl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00							
Be	.705	0.00	-.002	.369	-.391	0.00	-.269	0.00	1.00						
Sb	.202	-0.00	-.282	.322	.293	0.00	.434	0.00	-.284	1.00					
RF1	-.078	0.00	-.035	-.226	.342	0.00	-.021	0.00	-.451	.236	1.00				
RF2	-.312	0.00	-.072	-.109	.003	0.00	.200	0.00	-.516	.230	.057	1.00			
RF3	.182	0.00	.057	-.056	.192	0.00	-.030	0.00	.187	-.091	.528	-.818	1.00		
RF4	-.334	0.00	-.090	.202	-.271	-0.00	-.120	0.00	-.166	.014	-.327	.181	-.346	1.00	
TSLS	.281	0.00	.021	.215	.048	0.00	.455	0.00	.211	.190	-.227	-.402	.262	-.205	1.00

TABLE 6. CORRELATION MATRIX - BOTH PLANTS
(PLANT E AND PLANT J)

	pH	Acid.	Cond.	Cl	SO_4	D.Sol	S.Sol	Fe	Mn	SiO_2	Cu	Zn	Cr	Al	Ni	Ca
pH	1.00															
Acid.	.038	1.00														
Cond.	.042	.524	1.00													
Cl	-.626	.394	.752	1.00												
SO_4	.122	.841	.726	.746	1.00											
D.Sol	.130	.827	.810	.833	.898	1.00										
S.Sol	.220	-.305	-.042	-.124	-.074	-.021	1.00									
Fe	.179	.814	.642	.292	.868	.866	-.099	1.00								
Mn	.354	.714	.603	-.064	.745	.816	.101	.792	1.00							
SiO_2	.290	.666	.662	-.040	.719	.786	.148	.687	.864	1.00						
Cu	.351	.630	.526	-.315	.729	.694	.164	.760	.883	.837	1.00					
Zn	.177	.724	.697	.380	.708	.816	.028	.733	.717	.661	.681	1.00				
Cr	.005	-.178	-.132	-.078	-.232	-.160	-.046	-.259	-.199	-.215	-.188	-.248	1.00			
Al	.290	.731	.584	-.305	.672	.788	.095	.797	.899	.823	.807	.693	-.069	1.00		
Ni	.337	.796	.603	-.249	.814	.874	.076	.865	.943	.878	.904	.829	-.248	.904	1.00	
Ca	-.167	.486	.282	.655	.409	.381	.093	.251	.136	.095	.073	.294	-.063	.177	.188	1.00
Mg	.334	.845	.656	.824	.866	.846	-.165	.831	.831	.794	.772	.751	-.284	.728	.379	.218
Pb	0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00	0.00	-0.00
Hg	-.271	-.375	-.305	.101	-.310	-.389	-.171	-.444	-.642	-.539	-.606	-.464	-.095	-.577	-0.606	.046
Ba	-.027	.531	.696	.842	.610	.633	-.188	.441	.343	.329	.227	.478	-.139	.364	.433	.242
As	.408	.041	.241	-.286	.374	.248	.586	.236	.479	.512	.550	.130	.161	.424	.385	-.011
Cd	-.189	-.257	-.152	-.135	-.291	-.242	-.110	-.255	-.366	-.365	-.312	-.290	-.040	-.383	-.360	-.001
Se	.197	-.031	-.200	-.330	-.112	-.074	.159	-.056	.250	.123	.193	.101	-.154	.174	.170	-.155
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Be	.309	.700	.610	.281	.686	.789	-.107	.861	.861	.767	.803	.693	-.251	.770	.883	.019
Sb	.164	.493	.442	.647	.599	.535	.317	.270	.553	.674	.579	.538	.091	.537	.584	.255
RF1	-.309	.032	-.008	.369	.069	-.079	.131	-.128	-.109	-.194	-.119	.070	-.134	-.099	-.142	.039
RF2	.138	-.483	-.309	0.00	-.372	-.394	.325	-.537	-.615	-.338	-.285	-.048	.422	-.517	-.394	-.141
RF3	-.108	.413	.102	0.00	.281	.257	-.117	.391	.475	.119	.244	.113	-.306	.434	.259	.198
RF4	-.068	-.169	-.264	-.238	-.212	-.203	-.110	-.172	-.149	-.110	-.087	-.145	.337	-.164	-.138	-.177
TSLS	-.073	.128	.043	-1.00	.352	.240	-.018	.083	.498	.234	.341	.055	-.292	.135	.345	.212

TABLE 6 (continued)

	Mg	Pb	Hg	Ba	As	Cd	Se	Tl	Be	Sb	RF1	RF2	RF3	RF4	TSLS
Mg	1.00														
Pb	-0.00	1.00													
Hg	-.508	0.00	1.00												
Ba	.450	0.00	-.230	1.00											
As	.255	0.00	-.408	-.132	1.00										
Cd	-.293	0.00	.432	-.194	-.244	1.00									
Se	.222	0.00	-.284	.109	-.085	-.136	1.00								
Tl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Be	.834	-0.00	-.574	.324	.261	-.310	.163	0.00	1.00						
Sb	.459	-0.00	.422	.361	.462	-.344	.543	0.00	.198	1.00					
RF1	-.097	0.00	.107	.028	.101	-.184	-.079	0.00	-.334	.202	1.00				
RF2	-.312	0.00	-.072	-.109	.003	0.00	.200	0.00	-.516	.230	.057	1.00			
RF3	.182	0.00	.058	-.056	.192	0.00	-.030	0.00	.187	-.091	.528	-.818	1.00		
RF4	-.146	0.00	-.132	.163	-.111	-.073	-.067	0.00	.042	.089	-.287	.181	-.346	1.00	
TSLS	.281	0.00	.021	.215	.048	0.00	.455	0.00	.211	.190	-.227	-.402	.262	-.205	1.00

TVA

TABLE 7. CORRELATIONS WITH r VALUES >0.71

Parameter	Plant J	Plant E	Both plants
pH	0	0	0
Acidity	6	3	8
Conductivity	8	6	3
Cl	-	5	-
SO_4	8	6	11
TDS	11	7	12
TSS	0	0	0
Fe	7	3	10
Mn	8	6	12
SiO_2	4	0	8
Cu	2	0	8
Zn	2	4	7
Cr	0	1	1
Al	4	1	10
Ni	12	3	11
Ca	0	1	0
Mg	7	7	12
Pb	-	-	-
Hg	0	0	0
Ba	0	6	1
As	0	1	0
Cd	-	0	-
Sc	0	0	0
Ti	-	-	-
Be	5	0	8
RF1	0	0	0
RF2	0	-	-
TSLS	0	-	-
RF3	0	-	-
RF4	0	0	0

TABLE 9. ACID-BASE BALANCE

Sample No.	Laboratory potential acidity (ton/CaCO$_3$/1000 ton)	Calculated potential acidity (ton/CaCO$_3$/1000 ton)	Laboratory neutralization potential (ton CaCO$_3$/1000 ton)	Laboratory excess acidity* (ton CaCO$_3$/1000 ton)	Calculated excess acidity** (ton/CaCO$_3$/100 ton)
J776	15.5	45.5	<0.3	15.2	45.2
J876	14.0	47.5	<0.3	13.7	47.2
J1076	14.5	49.5	<0.3	14.2	49.2
E1076	43.5	102.5	7.6	35.9	94.9
E1176	43.5	103.5	0.8	42.7	102.7
E1276	34.5	112.0	7.6	26.9	104.4
E177	35.5	108.0	7.3	28.2	100.7
E277	31.0	101.5	1.1	29.9	100.4

*Laboratory potential acidity minus laboratory neutralization potential.

**Calculated potential acidity minus laboratory neutralization potential.

TABLE 10. COAL ANALYSIS--PLANTS J AND E

	Plant J					Plant E				
	J50A	J50B	J776	J876	J1076	E1076	E1176	E1276	E177	E277
Approximate analysis										
% total moisture	2.0	2.0	3.0	2.8	2.8	3.2	3.2	3.1	3.4	4.0
Dry basis										
% volatile matter	37.1	37.4	33.0	33.4	33.2	36.8	37.3	36.7	37.1	37.6
% ash	13.5	13.3	16.6	15.6	15.6	15.1	14.8	16.6	15.7	14.6
% fixed carbon	49.4	49.3	50.4	51.0	51.2	48.1	47.9	46.7	47.2	47.8
% total sulfur	1.9	1.7	2.11	2.04	2.12	4.09	4.15	4.51	4.27	4.10
Btu/lb										
As received	12,885	12,879								
Dry	13,117	13,160	12,048	12,183	12,252	12,293	12,414	12,082	12,210	12,351
A&MF	15,159	15,173	14,446	14,441	14,523	14,477	14,566	14,489	14,490	14,460
Forms of S (dry)										
% sulfate	0.04	0.04	0.46	0.32	0.33	0.27	0.28	0.22	0.24	0.32
% pyritic	0.82	0.69	0.69	0.76	0.81	2.13	2.21	2.54	2.39	2.06
% organic	1.02	0.96	0.96	0.96	0.98	1.69	1.66	1.75	1.64	1.72
% total	1.88	1.69	2.11	2.04	2.12	4.09	4.15	4.51	4.27	4.10
Particle size	As received	-18/+40	-18/+40	-18/+40	-18/+40	-18/+40	-18/+40	-18/+40	-18/+40	-18/+40

TABLE 11. COAL ANALYSIS - PLANT J

Sample Number	J50A	J50B
Analysis of Ash (%)		
SiO_2	51.6	52.4
Al_2O_3	27.9	28.2
Fe_2O_3	11.7	10.6
CaO	1.8	1.6
MgO	1.1	1.0
SO_3	1.4	1.7
Na_2O	0.3	0.3
K_2O	2.5	2.5
TiO_2	1.2	1.2
Analysis of Ash (mg/l)		
Mn	120	110
Pb	92	101
Cu	213	269

TABLE 12. RESULTS OF SHAKER TESTS--PLANTS J AND E

		PLANT J				PLANT E					
		J776	J876	J1076	Total	E1076	E1176	E1286	E177	E277	Total
pH	$\overline{X}$	2.64	2.75	2.73	2.70	7.12	6.46	6.83	6.49	5.94	6.57
	σ	0.01	0.02	0.02	0.05	0.48	0.26	0.10	0.20	0.35	0.49
	Range	2.62-2.66	2.73-2.77	2.70-2.75	2.62-2.77	6.47-7.90	6.10-6.82	6.70-6.94	6.23-6.66	5.51-6.38	5.51-7.90
	N	6	6	6	18	6	6	6	6	6	30
Fe	$\overline{X}$	250	183	170	201	0.23	0.30	0.21	0.17	0.44	0.27
	σ	39.50	19.66	30.98	46.39	0.18	0.22	0.08	0.19	0.24	0.20
	Range	210-310	160-210	140-220	140-310	<.05-.46	<.05-.53	0.07-0.30	<.05-.55	0.25-0.92	<.05-.92
	N	6	6	6	18	6	6	6	6	6	30
Mn	$\overline{X}$	1.70	1.32	1.37	1.46	1.03	1.22	1.03	1.23	1.95	1.28
	σ	0.17	0.12	0.08	0.21	0.19	0.36	0.26	0.29	0.29	0.44
	Range	1.5-2.0	1.2-1.5	1.3-1.5	1.2-2.0	0.83-1.2	0.87-1.6	0.78-1.3	0.95-1.5	1.6-2.3	0.78-2.3
	N	6	6	6	18	6	6	6	6	6	30
TDS	$\overline{X}$	1533	1067	1033	1211	1067	1200	1033	1033	1300	1127
	σ	57.74	57.74	57.74	247.2	57.74	100	57.74	57.74	100	128.0
	Range	1500-1600	1000-1100	1000-1100	1000-1600	1000-1100	1100-1300	1000-1100	1000-1100	1200-1400	1000-1400
	N	3	3	3	9	3	3	3	3	3	15
SO_4	$\overline{X}$	1100	813	813	909	700	790	723	717	850	756
	σ	0.00	23.09	23.09	144.3	45.83	26.46	15.28	25.17	266.3	118.4
	Range	1100-1100	800-840	800-840	800-1100	650-740	770-820	710-740	690-740	570-1100	570-1100
	N	3	3	3	9	3	3	3	3	3	15
Ni	$\overline{X}$	0.70	0.67	0.69	0.69	0.33	0.41	0.27	0.29	0.46	0.35
	σ	0.09	0.13	0.14	0.11	0.16	0.20	0.11	0.08	0.12	0.15
	Range	0.62-0.87	0.55-0.83	0.55-0.83	0.55-0.87	0.17-0.50	0.20-0.65	0.17-0.44	0.22-0.42	0.37-0.69	0.17-0.62
	N	6	6	6	18	6	6	6	6	6	30

TABLE 13. CHEMICAL COMPOSITION OF COAL PILE DRAINAGE USED FOR TREATMENT STUDY

Constituent	Concentration (mg/L)	
	Total	Dissolved
Acidity, as $CaCO_3$	9,100	
Total dissolved solids		19,000
Total suspended solids	6	
Iron	3,000	3,000
Manganese	46	44
Zinc	12	12
Nickel	4.4	4.4
Copper	1.6	1.3
Arsenic	0.28	0.28
Selenium	<0.001	<0.001
Chromium	<0.005	<0.005
Mercury	<0.002	<0.0002

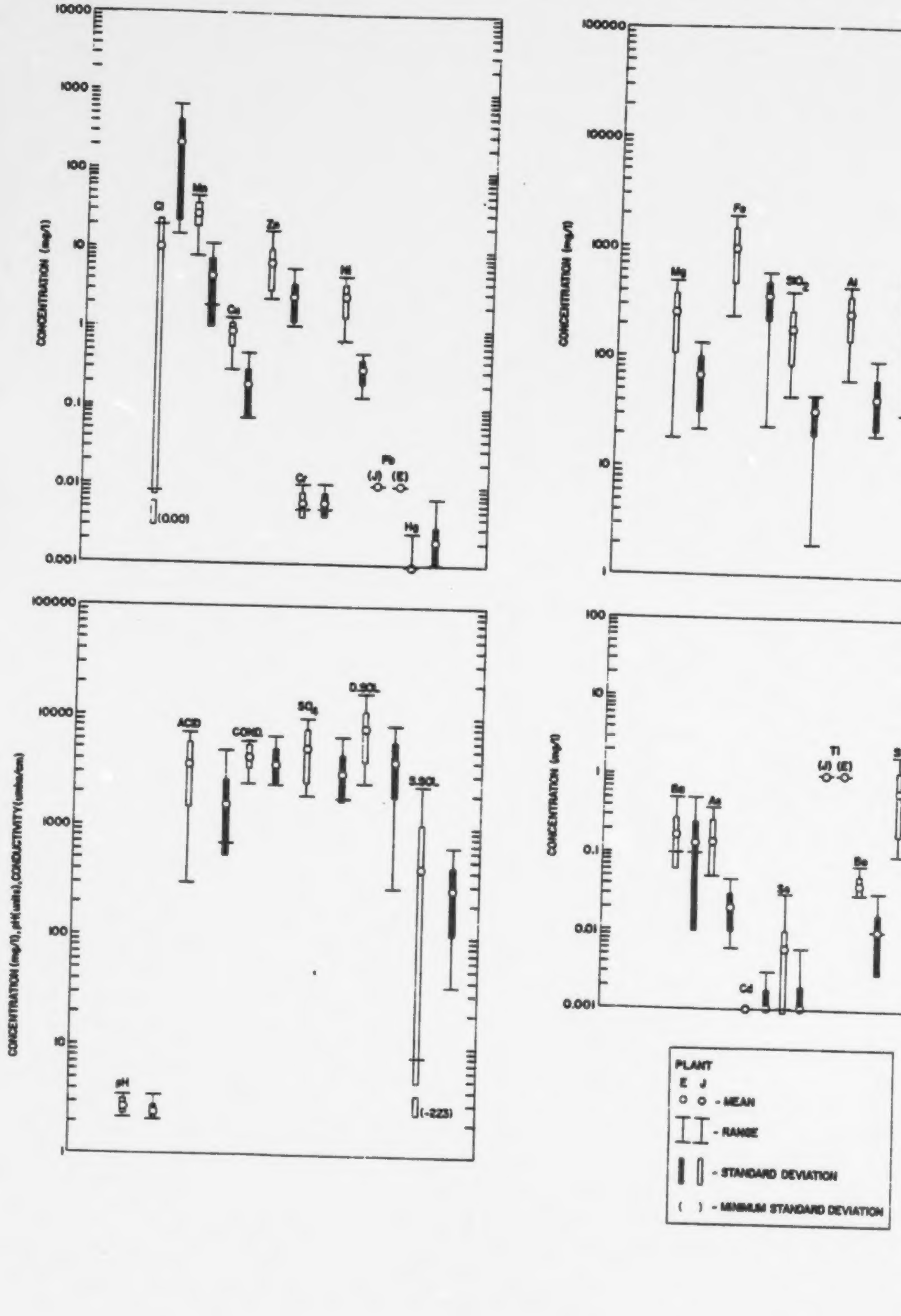
TABLE B-2. RAINFALL-RUNOFF DATA - PLANT J

Test period (1977)	Rainfall (in)	Pumping time (h)
03/30-04/03	2.65	71.5
04/12-04/15	0.12	13.0
04/22-04/25	0.95	6.5
05/01-05/03	1.03	14.0
05/07-05/08	0.53	5.5
05/11-05/19	5.05	114.5
05/28-06/01	3.35	96.75
06/02-06/05	2.24	38.0
06/11-06/21	2.03	41.5
06/25-06/30	1.87	25.75
07/02-07/06	1.6	56.75
07/08-07/17	0.85	22.0
07/22-07/22	0.1	15.75
07/26-08/08	0.55	13.25
08/15-08/18	0.45	12.75
08/26-08/28	0.30	6.5
08/31-09/06	1.05	11.75
09/20-09/27	2.95	78.0
09/29-10/10	1.1	14.25
10/12-10/15	0.05	1.0
10/17-10/25	3.77	72.75
10/30-11/11	0.9	17.75

TABLE B-3. WEIR READINGS FOR DETERMINATION OF PUMPING RATE

Date	H	Flow (cfs)	Flow (gal/min)
03-11-77	0.34	1.94	870.67
03-12-77	0.33	1.85	830.28
03-13-77	0.35	2.02	906.58
03-14-77	0.38	2.28	1,023.26
03-20-77	0.38	2.28	1,023.26
03-28-77	0.375	2.225	998.58
03-30-77	0.395	2.37	1,063.66
03-31-77	0.37	2.19	982.87
04-03-77	0.31	1.69	758.47
04-06-77	0.33	1.85	830.28
04-08-77	0.33	1.85	830.28
04-16-77	0.32	1.77	794.38
04-19-77	0.35	2.02	906.58
04-23-77	0.32	1.77	794.38
04-24-77	0.34	1.94	870.67
04-25-77	0.31	1.69	758.47
04-26-77	0.34	1.94	870.67
05-01-77	0.36	2.11	946.97
05-03-77	0.36	2.11	946.97
05-21-77	0.32	1.77	794.00
05-23-77	0.32	1.77	794.00
05-24-77	0.31	1.69	758.00
06-14-77	0.30	1.61	723.40
06-20-77	0.29	1.53	686.00
06-20-77	0.21	0.948	425.00
06-21-77	0.17	0.692	311.00
06-21-77	0.22	1.02	458.00
06-21-77	0.15	0.575	258.00
06-23-77	0.28	1.45	651.00
06-24-77	0.20	0.881	395.00
06-27-77	0.29	1.53	687.00
$\bar{X}$	0.315	1.72	771.00
s	0.085	0.47	208.2

Figure 6. Physicochemical data for plants J and E.



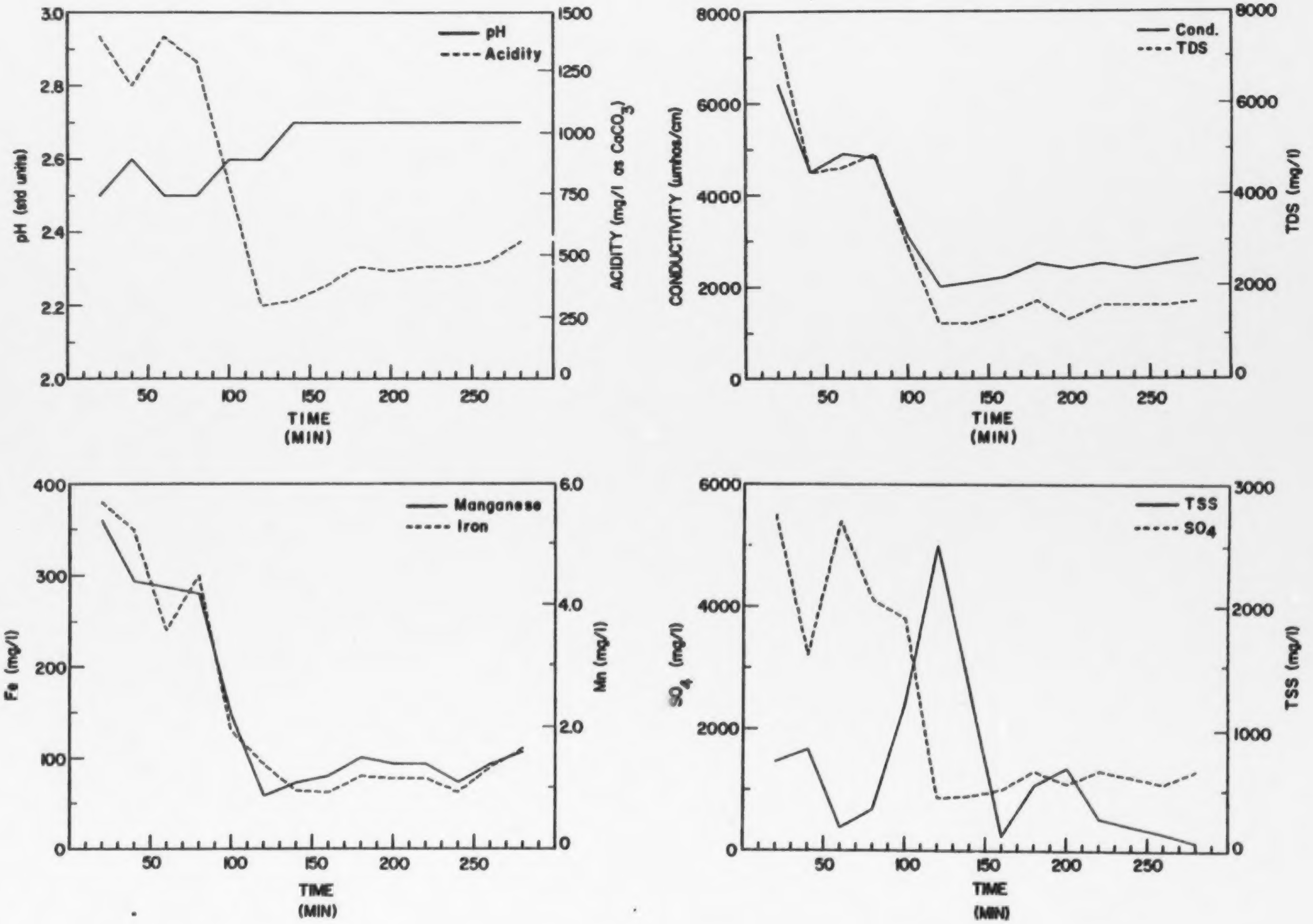


Figure 7. Results of discrete storm analysis.

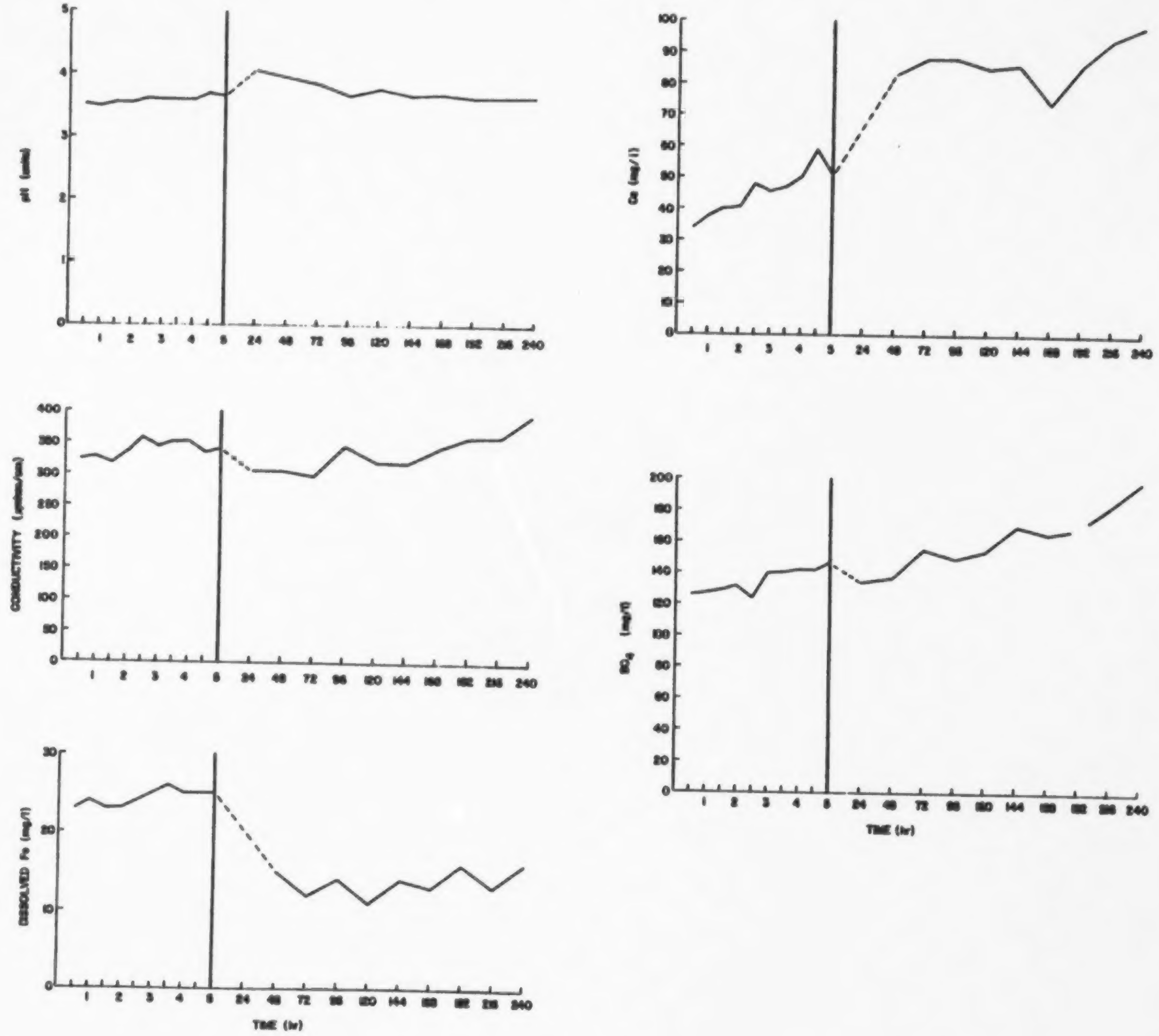


Figure 8. Results of time to equilibrium analyses.

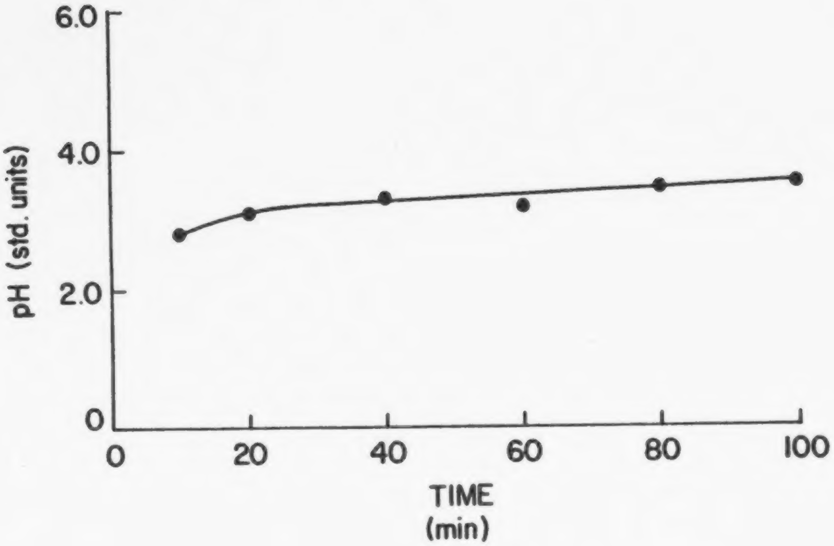


Figure 9. Coal pH.

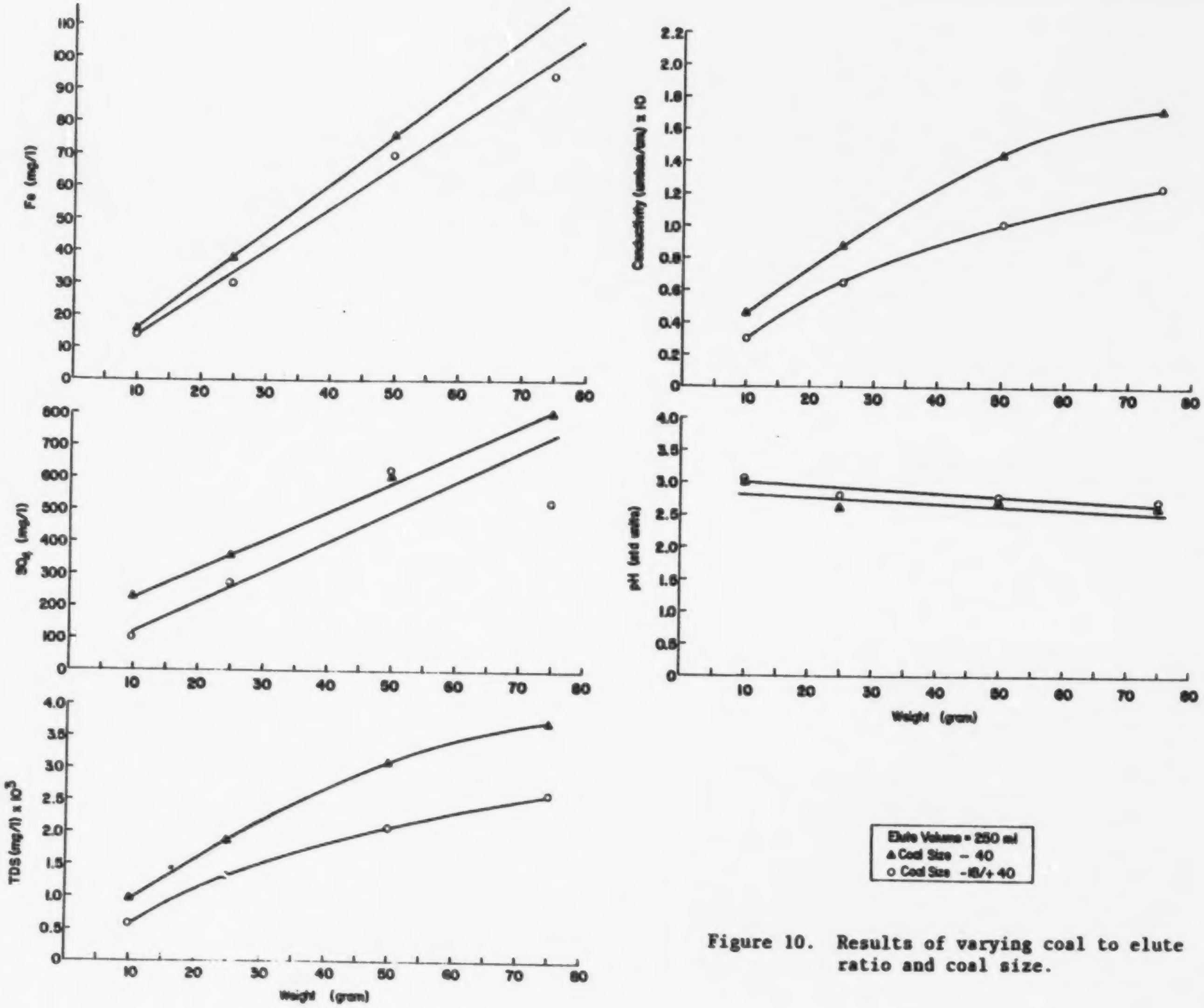


Figure 10. Results of varying coal to elute ratio and coal size.

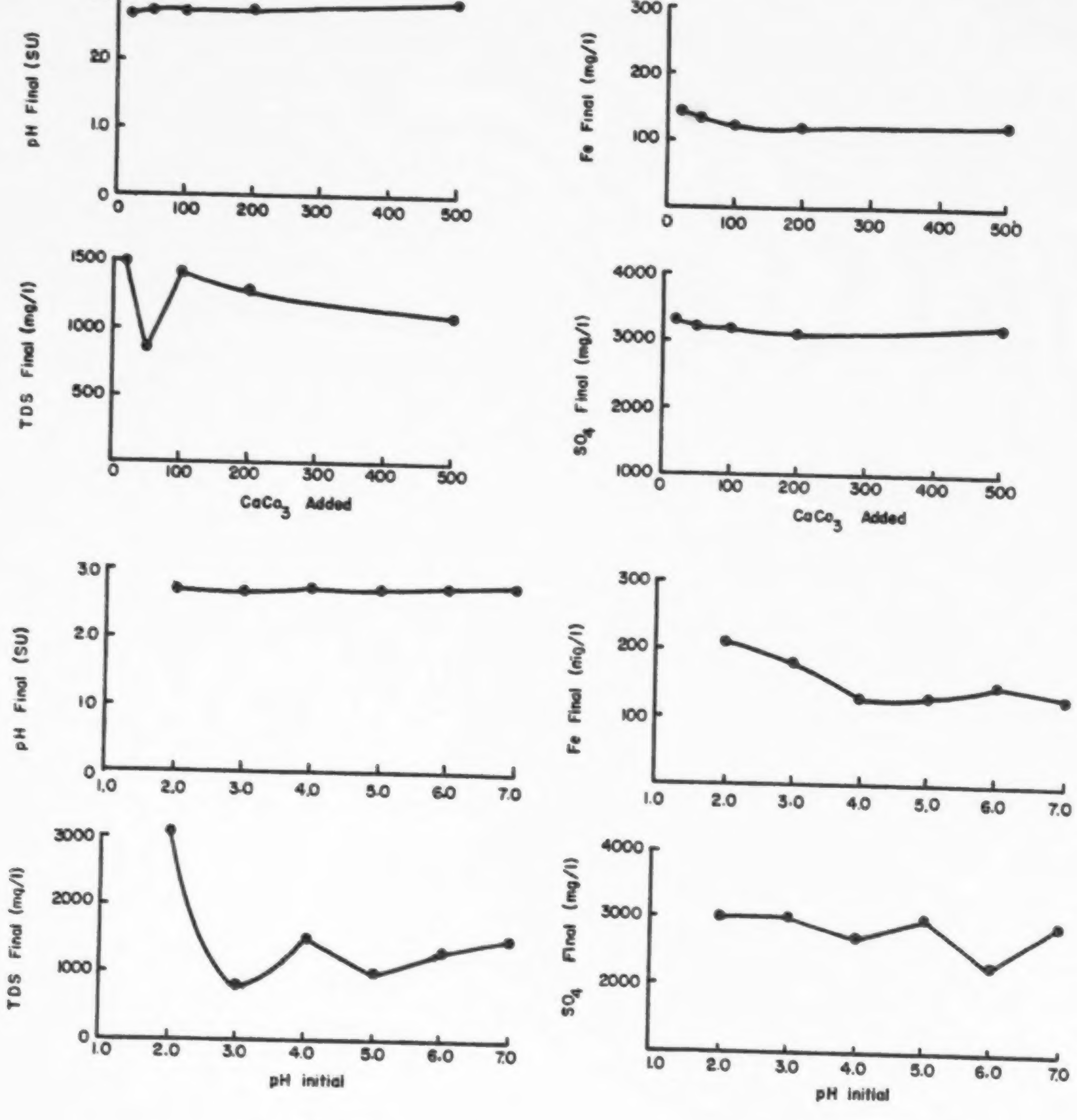


Figure 11. Results of varying elute pH and hardness.

STUDY NUMBER 6

DATA SOURCE:	**LEVEL 1 ASSESSMENT OF LIMESTONE SCRUBBING WITH ADIPIC ACID ADDITION**
DATA STATUS:	Draft, April 30, 1979
AUTHORS:	James E. Howes, Jr., Rachael Barbour, Doyle F. Kohler, and Alf Bjorseth
CONTRACTOR:	Battelle-Columbus Laboratories 505 King Avenue Columbus, Ohio 43201
PROJECT OFFICER:	John E. Williams U.S. Environmental Protection Agency Research Triangle Park, NC 27711

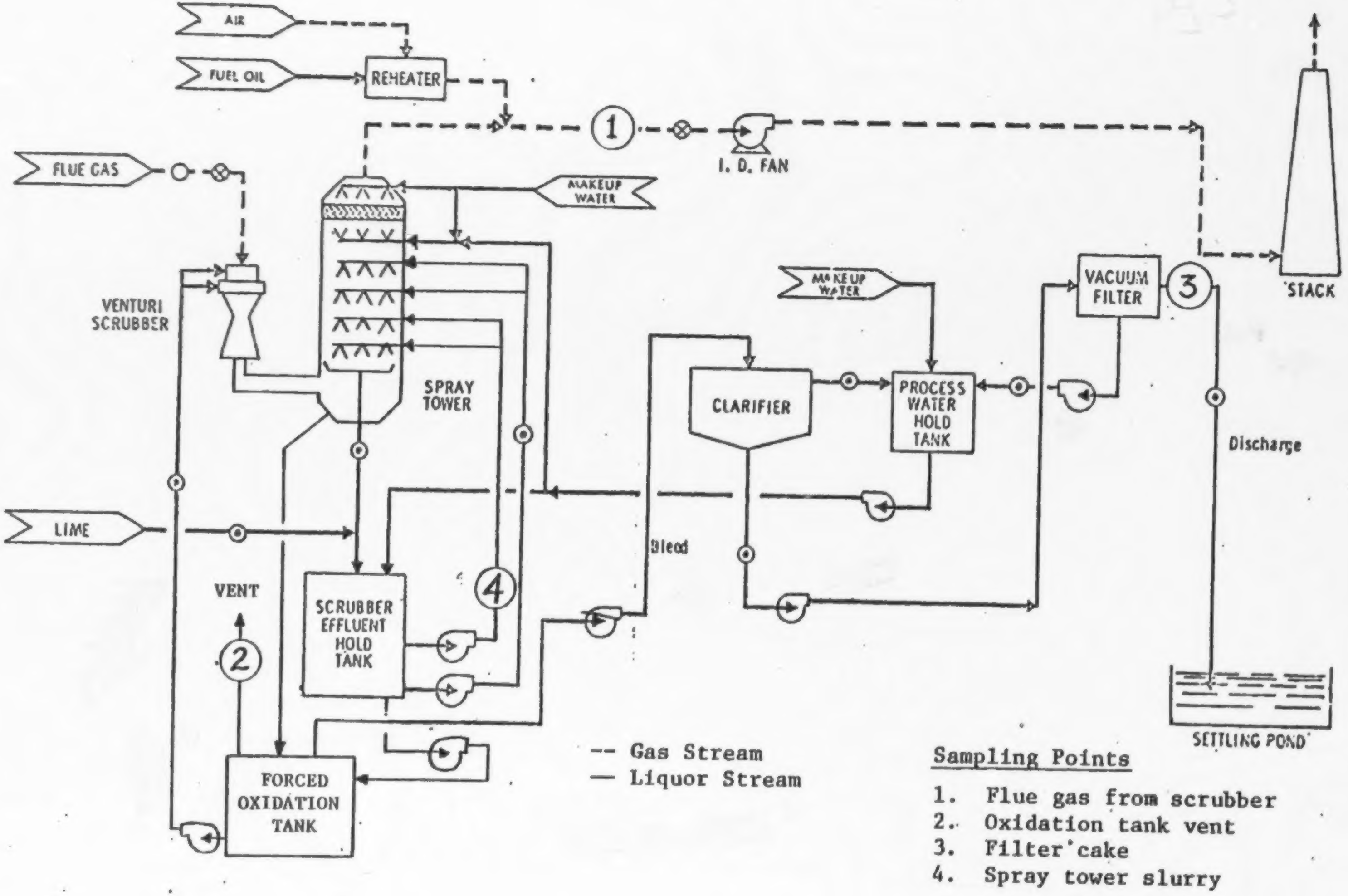
LEVEL 1 ASSESSMENT OF LIMESTONE SCRUBBING WITH ADIPIC ACID ADDITION

This study was conducted January 29, 1979, through February 2, 1979, at the EPA Alkali Wet Scrubber Test Facility at the Shawnee Steam Plant, a coal-fired power plant near Paducah, Kentucky. The purposes of the study were (1) to evaluate the ability of adipic acid, at about 1,600 ppm in a limestone-water slurry, to enhance the removal of SO_2 from effluent gases (as compared to a limestone-water slurry without adipic acid) and (2) to determine if adipic acid and its reaction products in the effluent gas might have caused environmental detriment. Samples, as shown by the circled numbers, were taken from a venturi/spray tower system, shown in Figure 6-1, and from a turbulent contact absorber (TCA) system, shown in Figure 6-2.

Sampling procedures followed the Level 1 Procedures Manual[1], and the samples were obtained and analyzed as shown in Table 6-1.

Table 6-1. Sample Analysis

Control device		Sample	On-site GC	SASS, particulates	Level 1 organic	Level 1 inorganic	Bioassay
Venturi/spray tower system	1.	Scrubber/spray tower gas	✓	✓	✓	✓	✓
	2.	Forced-oxidation tank vent emissions	✓	✓	✓	✓	✓
	3.	Solids cake from vacuum filter			✓	✓	✓
	4.	Spray tower slurry feed			✓	✓	✓
TCA system	1.	Scrubber stack gas	✓	✓	✓	✓	✓
	2.	Solids cake from centrifuge			✓	✓	✓


AIR
FUEL OIL
REHEATER
FLUE GAS
1
I. D. FAN
MAKEUP WATER
VENTURI SCRUBBER
SPRAY TOWER
MAKEUP WATER
CLARIFIER
PROCESS WATER HOLD TANK
VACUUM FILTER
3
STACK
Discharge
LIME
Bleed
VENT
2
SCRUBBER EFFLUENT HOLD TANK
4
FORCED OXIDATION TANK
SETTLING POND

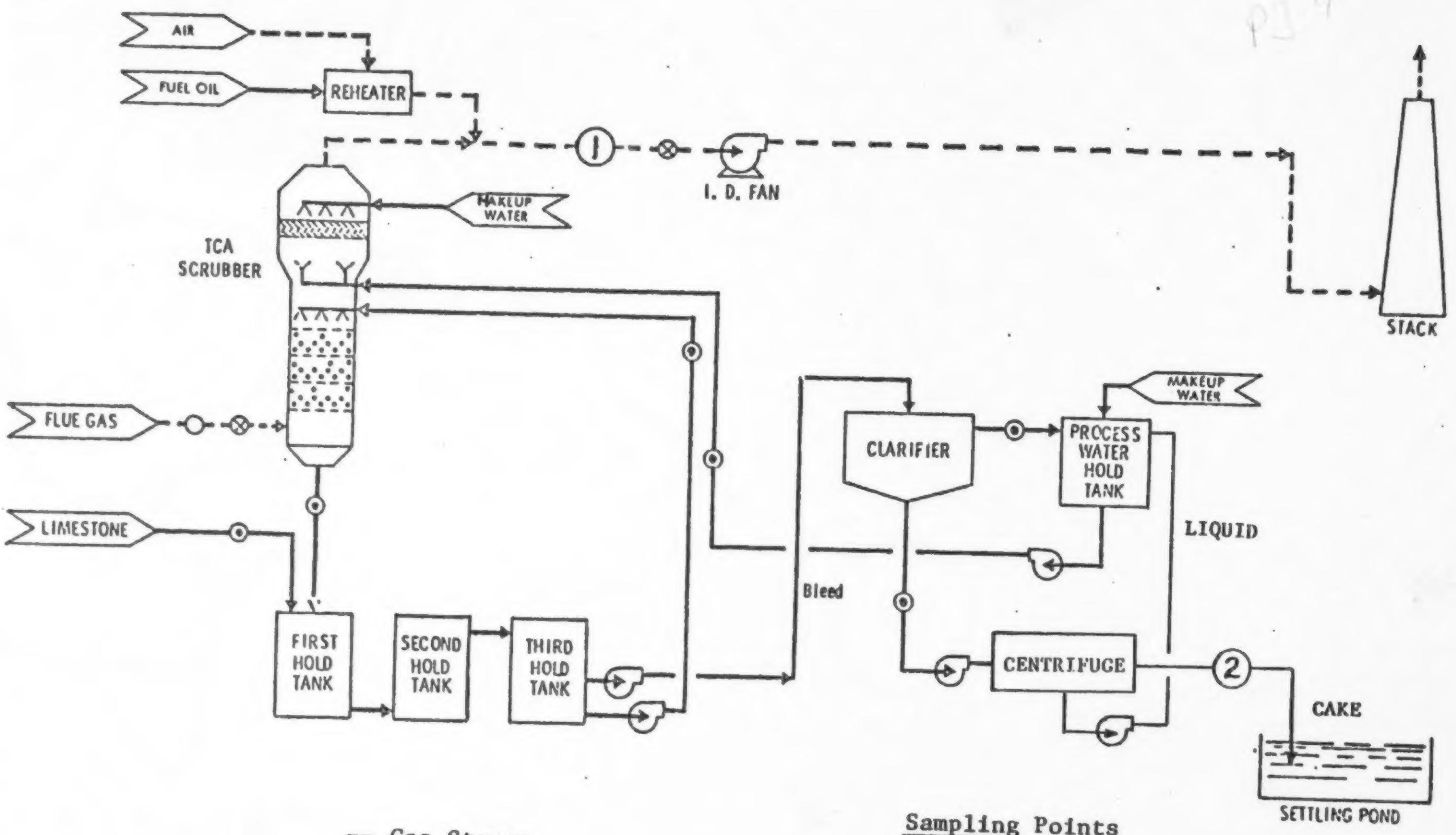
-- Gas Stream
— Liquor Stream

Sampling Points

1. Flue gas from scrubber
2. Oxidation tank vent
3. Filter cake
4. Spray tower slurry

Figure 6-1. Process flow diagram for venturi/spray tower system.

pg 4


AIR
FUEL OIL
REHEATER
1
I. D. FAN
STACK
MAKEUP WATER
TCA SCRUBBER
FLUE GAS
LIMESTONE
FIRST HOLD TANK
SECOND HOLD TANK
THIRD HOLD TANK
Bleed
CLARIFIER
MAKEUP WATER
PROCESS WATER HOLD TANK
LIQUID
CENTRIFUGE
2
CAKE
SETTLING POND

-- Gas Stream
— Liquor Stream

Sampling Points

1. Flue gas from scrubber
2. Centrifuge cake

Figure 6-2. Process flow diagram for TCA system.

Onsite gas chromatography for CO_2, CO, O_2, N_2, sulfur compounds, and hydrocarbons (bp <100° C) was performed according to Level 1 procedures. It was found that Level 1 procedures for SO_2 caused problems due to the reaction of SO_2 with H_2O which condensed in the glass sampling bulbs. Therefore, SO_2 was measured by continuous monitors operated by the power plant. SO_2 and another unidentified volatile sulfur compound (with a relative retention time of 0.53 relative to SO_2 on a 36 ft × 1/8 in. polyphenylether/H_3PO_4 column) were detected in all three gaseous samples. The concentration of the unidentified sulfur compound was estimated at:

Sample	mg S/m^3
Venturi scrubber/spray tower gas	7.2
Forced-oxidation tank vent emissions	9
TCA scrubber stack gas	9.4

There was no CO detected in any samples. Analytical results for CO_2, O_2, SO_2, and hydrocarbons are presented in the data tables that follow this written summary.

SASS samples were also taken of the three gaseous streams. Procedures for SASS sampling were as specified in the Level 1 Manual except that hyper-isokinetic sampling rate was employed in sampling the oxidation tank vent because the required size of the SASS probe nozzle was not available; this should not have adversely affected test results because this emission did not contain appreciable amounts of particulates.

SASS samples were analyzed by Level 1 procedures except that LC fractionation was not performed on the 10 ±3 μm particulates in the venturi and TCA samples and on the filter in the oxidation tank vent sample. The Level 1 procedure specifies that LC fractionation does not need to be performed if the total particulate catch is less than 0.5 mg/30 m^3. Corrected to 30 m^3, particulate catches for the three gaseous samples were:

Venturi scrubber/spray tower gas	477 mg/30 m^3
Forced-oxidation tank vent emissions	10 mg/30 m^3
TCA scrubber stack gas	410 mg/30 m^3

(It appears that a cutoff of 0.5 g rather than 0.5 mg may have been used here.)

It is of interest, relative to the goals of the study, that IR analysis of the venturi effluent sample indicated adipic acid, but the presence of adipic acid was not confirmed by LRMS. Several suspect contaminants were identified by IR in this sample: silicones and phthalates, possibly from sampling or process equipment; polychlorotrifluoroethylene, possibly from Viton gaskets in the SASS train; and diethylene glycol, which is listed as an antifreeze solution for sprinkler systems in the Merck Index[2].

No fugitive emissions samples were taken in this study. Level 1 grab techniques were used to obtain samples of the venturi spray tower slurry, the venturi filter cake, and the TCA centrifuge cake.

The following samples were taken for bioassay:

Venturi Scrubber System

1. 350 mg of SASS particulates from stack gas test
2. 2 mL of SASS XAD-2 extract from stack gas test
3. 2 mL of SASS XAD-2 extract from forced-oxidation tank vent test
4. 500 g of venturi filter cake
5. 1 L of venturi spray tower slurry

A SASS particulate sample was not obtained from the oxidation tank vent emissions.

TCA Scrubber System

1. 350 mg of SASS particulates from stack gas test
2. 2 mL of SASS XAD-2 extract from stack gas test
3. 500 g TCA centrifuge cake

Level 1 sample handling procedures were followed, according to the report, but due to difficulty with the solvent exchange procedure into DMSO, the XAD-2 extracts are estimated to contain about 10 percent methylene chloride, which could affect bioassay results. No bioassay results were presented in this draft report.

LEVEL 1

TABLE 6-2. SPARK SOURCE MASS SPECTROSCOPY SASS FILTER PARTICULATES--OXIDATION TANK VENT
(μg/m^3*)

U	<0.0196	Dy	<0.0491	Rh	<0.0327	Cr	0.485
Th	<0.0392	Tb	<0.0164	Ru	<0.196	V	†
Bi	<0.0196	Gd	<0.0491	Mo	0.0491	Ti	†
Pb	0.0977	Eu	<0.0229	Nb	0.00647	Sc	0.0244
Tl	<0.131	Sm	<0.0491	Zr	<0.0164	Ca	3.17
Hg	<0.654	Nd	0.0323	Y	<0.00981	K	†
Au	<0.0196	Pr	<0.0131	Sr	0.00301	Cl	†
Pt	<0.0654	Ce	0.0122	Rb	0.00647	S	†
Ir	<0.0327	La	0.00981	Br	0.0377	P	†
Os	<0.0654	Ba	†	Se	<0.0687	Si	2.18
Re	<0.0327	Cs	0.00147	As	0.00799	Al	1.86
W	<0.0654	I	†	Ge	0.0196	Mg	1.51
Ta	<0.0491	Te	<0.0327	Ga	<0.00654	Na	†
Hf	<0.0491	Sb	†	Zn	†	F	0.0750
Lu	<0.0491	Sn	0.0733	Cu	0.160	B	0.170
Yb	<0.0491	In	0.00491	Ni	0.0754	Be	<0.00164
Tm	<0.0164	Cd	0.147	Co	0.00395	Li	0.00832
Er	<0.0491	Ag	<0.00589	Fe	1.43		
Ho	<0.0164	Pd	<0.0981	Mn	0.236		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-3. SPARK SOURCE MASS SPECTROSCOPY SASS PROBE AND CYCLONE RINSE RESIDUE-- VENTURI SCRUBBER ($\mu g/m^3$*)

U	0.0331	Dy	0.0828	Rh	<0.00497	Cr	49.7
Th	0.0663	Tb	0.00828	Ru	<0.00828	V	.990
Bi	<0.00828	Gd	0.0497	Mo	8.28	Ti	24.9
Pb	0.497	Eu	0.0331	Nb	0.166	Sc	<0.249
Tl	0.331	Sm	0.0497	Zr	0.828	Ca	4,970
Hg	<0.0497	Nd	0.166	Y	0.166	K	82.8
Au	<0.00166	Pr	0.0331	Sr	3.31	Cl	33.1
Pt	<0.00497	Ce	0.166	Rb	0.232	S	497
Ir	<0.00331	La	0.166	Br	2.90	P	6.63
Os	<0.00331	Ba	16.6	Se	0.499	Si	149
Re	<0.00497	Cs	0.0249	As	2.49	Al	24.8
W	0.331	I	†	Ge	.497	Mg	82.8
Ta	<0.00828	Te	<0.00497	Ga	.0828	Na	49.7
Hf	<0.00828	Sb	0.0990	Zn	4.97	F	1.66
Lu	<0.00166	Sn	0.166	Cu	1.66	B	0.496
Yb	0.0331	In	<0.000828	Ni	24.9	Be	0.00828
Tm	0.00497	Cd	<0.249	Co	0.414	Li	0.497
Er	0.0166	Ag	0.0990	Fe	249		
Ho	0.00828	Pd	<0.0166	Mn	14.9		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-4. SPARK SOURCE MASS SPECTROSCOPY
SASS 10- and 3-μm PARTICULATES--
VENTURI SCRUBBER
(μg/m^3*)

U	<0.0111	Dy	<0.0223	Rh	<0.00668	Cr	13.4
Th	<0.0223	Tb	<0.00668	Ru	<0.0223	V	0.334
Bi	<0.0111	Gd	<0.0223	Mo	1.11	Ti	2.23
Pb	.0668	Eu	<0.0223	Nb	0.0445	Sc	<0.0445
Tl	.223	Sm	<0.0223	Zr	0.111	Ca	223
Hg	<0.445	Nd	<0.0445	Y	0.0445	K	4.45
Au	<0.0111	Pr	<0.0111	Sr	0.312	Cl	22.2
Pt	<0.0223	Ce	0.0334	Rb	<0.00445	S	223
Ir	<0.0223	La	0.0223	Br	0.167	P	0.445
Os	<0.0445	Ba	2.23	Se	0.670	Si	13.0
Re	<0.0223	Cs	<0.00167	As	0.0556	Al	33.3
W	0.0223	I	<0.0234	Ge	<0.223	Mg	4.45
Ta	<0.0223	Te	<0.0445	Ga	<0.0223	Na	1.32
Hf	<0.0223	Sb	0.0267	Zn	0.0445	F	<0.134
Lu	<0.0111	Sn	0.0445	Cu	0.111	B	0.667
Yb	<0.0223	In	<0.00556	Ni	5.56	Be	0.00223
Tm	<0.0111	Cd	<0.0668	Co	0.111	Li	<0.000334
Er	<0.0223	Ag	<0.00668	Fe	134		
Ho	<0.0111	Pd	<0.0445	Mn	1.33		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-5. SPARK SOURCE MASS SPECTROSCOPY SASS 1-μm AND FILTER PARTICULATES-- VENTURI SCRUBBER--
(μg/m^3*)

U	3.47	Dy	0.868	Rh	<0.174	Cr	21.8
Th	0.695	Tb	0.289	Ru	<0.347	V	174
Bi	2.32	Gd	0.868	Mo	28.9	Ti	576
Pb	40.2	Eu	0.405	Nb	0.175	Sc	1.09
Tl	347	Sm	0.868	Zr	2.32	Ca	17,300
Hg	<1.16	Nd	2.61	Y	4.05	K	840
Au	<0.0347	Pr	0.523	Sr	46.1	Cl	44.1
Pt	<0.116	Ce	2.86	Rb	11.5	S	23,100
Ir	<0.0579	La	1.74	Br	1.88	P	344
Os	<0.116	Ba	169	Se	15.1	Si	241
Re	<0.0579	Cs	0.868	As	289	Al	1,170
W	2.89	I	0.347	Ge	5.79	Mg	133
Ta	<0.0868	Te	1.74	Ga	28.9	Na	221
Hf	0.174	Sb	20.3	Zn	284	F	3.28
Lu	0.0868	Sn	34.5	Cu	113	B	86.2
Yb	0.289	In	0.579	Ni	12.4	Be	2.89
Tm	0.0868	Cd	26.0	Co	4.24	Li	8.67
Er	0.579	Ag	0.347	Fe	4,310		
Ho	0.174	Pd	<0.579	Mn	37.1		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-6. SPARK SOURCE MASS SPECTROSCOPY
SASS XAD-2 RESIN--VENTURI SCRUBBER
(μg/m^3*)

U	<1.50	Dy	<3.75	Rh	<0.750	Cr	†
Th	<3.00	Tb	<1.25	Ru	<2.50	V	3.01
Bi	<1.50	Gd	<3.75	Mo	11.3	Ti	†
Pb	7.79	Eu	<2.50	Nb	<0.750	Sc	<2.50
Tl	<10.0	Sm	<3.75	Zr	<2.50	Ca	1,630
Hg	<50.0	Nd	<3.75	Y	<0.750	K	†
Au	<1.50	Pr	<1.00	Sr	0.656	Cl	†
Pt	2.06	Ce	0.625	Rb	†	S	1,260
Ir	<2.50	La	1.27	Br	0.516	P	20.2
Os	<5.00	Ba	5.04	Se	0.0866	Si	112
Re	<2.50	Cs	<1.12	As	†	Al	1.11
W	0.0413	I	†	Ge	<2.50	Mg	100
Ta	<12.5	Te	<5.00	Ga	<0.625	Na	6.16
Hf	<2.50	Sb	<0.750	Zn	25.4	F	<5.00
Lu	<1.25	Sn	20.1	Cu	†	B	3.81
Yb	<3.75	In	<0.375	Ni	†	Be	<0.0250
Tm	<7.50	Cd	<7.50	Co	†	Li	0.762
Er	<3.75	Ag	0.762	Fe	8.65		
Ho	<1.25	Pd	<5.00	Mn	†		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-7. SPARK SOURCE MASS SPECTROSCOPY SASS CONDENSATE AND FIRST IMPINGER--VENTURI SCRUBBER
(μg/m^{3}*)

U	<0.495	Dy	<2.97	Rh	<0.495	Cr	2,970
Th	<0.989	Tb	<0.297	Ru	<0.989	V	14.8
Bi	<0.495	Gd	<0.989	Mo	495	Ti	989
Pb	<0.989	Eu	<0.989	Nb	0.297	Sc	<1.98
Tl	<1.98	Sm	<0.989	Zr	<0.495	Ca	148
Hg	<19.8	Nd	<4.95	Y	<0.198	K	49.4
Au	<0.495	Pr	<0.297	Sr	0.593	Cl	95.9
Pt	<0.989	Ce	<0.148	Rb	0.0989	S	178,000
Ir	<0.989	La	<0.297	Br	7.42	P	11.9
Os	<1.98	Ba	1.98	Se	43.6	Si	74.2
Re	<0.989	Cs	<0.148	As	<0.148	Al	17.8
W	<0.989	I	2.97	Ge	<2.97	Mg	4.95
Ta	<0.989	Te	<0.989	Ga	<0.247	Na	86,100
Hf	<0.989	Sb	<0.297	Zn	19.8	F	<9.89
Lu	<0.495	Sn	49.5	Cu	98.9	B	1.44
Yb	<0.989	In	<0.247	Ni	1,980	Be	<0.0495
Tm	<2.97	Cd	<2.97	Co	98.9	Li	0.00593
Er	<0.989	Ag	5.93	Fe	13,100		
Ho	<2.97	Pd	<1.98	Mn	297		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-8. SPARK SOURCE MASS SPECTROSCOPY SASS PROBE AND CYCLONE RINSE RESIDUE--OXIDATION TANK VENT

(μg/m^3*)

U	0.0000141	Dy	0.0000141	Rh	<0.00000422	Cr	0.127
Th	0.0000281	Tb	0.00000703	Ru	<0.00000703	V	0.00127
Bi	<0.00000281	Gd	0.0000281	Mo	0.00492	Ti	0.00703
Pb	0.00141	Eu	0.00000703	Nb	0.000141	Sc	<0.0000844
Tl	0.000141	Sm	0.0000422	Zr	0.000985	Ca	2.11
Hg	<0.0000422	Nd	0.000141	Y	0.0000985	K	0.0422
Au	<0.00000141	Pr	0.0000281	Sr	0.00281	Cl	0.0281
Pt	<0.00000422	Ce	0.0000703	Rb	0.000197	S	0.281
Ir	<0.00000281	La	0.0000985	Br	0.00352	P	0.00281
Os	<0.00000281	Ba	0.0141	Se	0.00190	Si	0.0842
Re	<0.00000422	Cs	0.0000211	As	0.000211	Al	0.0844
W	0.000422	I	0.0105	Ge	0.000422	Mg	0.0703
Ta	<0.0000703	Te	<0.00000422	Ga	0.0000352	Na	0.0422
Hf	<0.00000703	Sb	0.0000844	Zn	0.0281	F	0.00141
Lu	<0.00000141	Sn	0.000281	Cu	0.00352	B	0.00843
Yb	0.0000281	In	<0.000000703	Ni	0.0703	Be	0.00000703
Tm	0.00000703	Cd	<0.000211	Co	0.00141	Li	0.000127
Er	0.00000703	Ag	0.000844	Fe	0.211		
Ho	0.00000422	Pd	<0.0000141	Mn	0.0127		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-9. SPARK SOURCE MASS SPECTROSCOPY
SASS XAD-2 RESIN--OXIDATION TANK VENT
(μg/m^3*)

U	1.38	Dy	<3.45	Rh	<0.690	Cr	†
Th	†	Tb	<1.15	Ru	<2.30	V	†
Bi	<1.38	Gd	<3.45	Mo	1.14	Ti	†
Pb	†	Eu	<2.30	Nb	<0.690	Sc	<2.30
Tl	<9.20	Sm	<3.45	Zr	<2.30	Ca	114
Hg	<46.0	Nd	<3.45	Y	<0.690	K	†
Au	<1.38	Pr	†	Sr	†	Cl	†
Pt	†	Ce	0.575	Rb	†	S	†
Ir	<2.30	La	†	Br	†	P	18.4
Os	<4.60	Ba	†	Se	<3.22	Si	172
Re	<2.30	Cs	<1.03	As	†	Al	†
W	†	I	†	Ge	<2.30	Mg	†
Ta	<16.1	Te	<4.60	Ga	<0.575	Na	†
Hf	<2.30	Sb	<0.690	Zn	†	F	<4.60
Lu	<1.15	Sn	<2.30	Cu	†	B	†
Yb	<3.45	In	<0.345	Ni	†	Be	<.0230
Tm	<6.90	Cd	<6.90	Co	†	Li	.686
Er	<3.45	Ag	<0.690	Fe	†		
Ho	<1.15	Pd	<4.60	Mn	†		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-10. SPARK SOURCE MASS SPECTROSCOPY SASS CONDENSATE AND FIRST IMPINGER--OXIDATION TANK VENT

($\mu g/m^3$*)

U	<0.218	Dy	<1.31	Rh	<0.218	Cr	65.5
Th	<0.437	Tb	<0.131	Ru	<0.437	V	0.655
Bi	<0.218	Gd	<0.437	Mo	6.55	Ti	109
Pb	0.437	Eu	<0.437	Nb	0.0873	Sc	<0.873
Tl	<0.873	Sm	<0.437	Zr	<0.218	Ca	65.3
Hg	<8.73	Nd	<0.437	Y	<0.0873	K	43.7
Au	<0.218	Pr	<0.873	Sr	0.175	Cl	26,200
Pt	<0.437	Ce	<0.0655	Rb	0.0262	S	7,860
Ir	<0.437	La	<0.873	Br	0.546	P	5.24
Os	<0.873	Ba	2.18	Se	0.917	Si	32.7
Re	<0.437	Cs	<0.0655	As	<0.0655	Al	24.9
W	<0.437	I	†	Ge	<0.873	Mg	2.18
Ta	<2.18	Te	<0.437	Ga	<0.437	Na	14,400
Hf	<0.437	Sb	0.131	Zn	4.37	F	<4.37
Lu	<0.218	Sn	43.7	Cu	6.55	B	6.53
Yb	<0.437	In	<0.0655	Ni	43.7	Be	<0.0218
Tm	<1.31	Cd	<1.31	Co	0.655	Li	0.0131
Er	<0.437	Ag	2.62	Fe	262		
Ho	<1.31	Pd	<0.873	Mn	13.1		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-11. SPARK SOURCE MASS SPECTROSCOPY SASS PROBE AND CYCLONE RINSE RESIDUE-- TCA SCRUBBER

($\mu g/m^{3}$*)

U	0.0847	Dy	0.169	Rh	<0.00508	Cr	15.2
Th	0.169	Tb	0.0169	Ru	<0.00847	V	2.54
Bi	<0.00339	Gd	0.169	Mo	0.254	Ti	84.7
Pb	0.0847	Eu	0.0847	Nb	0.169	Sc	0.339
Tl	0.0339	Sm	0.169	Zr	1.19	Ca	2,540
Hg	<0.0508	Nd	0.847	Y	0.847	K	8.47
Au	<0.00169	Pr	0.169	Sr	1.69	Cl	8.42
Pt	<0.00508	Ce	0.593	Rb	0.169	S	508
Ir	<0.00339	La	0.847	Br	0.423	P	13.5
Os	<0.00339	Ba	16.9	Se	0.273	Si	1,020
Re	<0.00339	Cs	0.0508	As	0.423	Al	1,020
W	0.0339	I	<0.0127	Ge	1.19	Mg	16.9
Ta	<0.0339	Te	<0.00508	Ga	0.0847	Na	3.04
Hf	<0.00847	Sb	0.0508	Zn	0.169	F	1.69
Lu	<0.00169	Sn	0.0847	Cu	1.69	B	0.507
Yb	0.0339	In	<0.000847	Ni	4.23	Be	0.0254
Tm	0.0169	Cd	<0.102	Co	1.69	Li	0.508
Er	0.0339	Ag	0.0152	Fe	508		
Ho	0.0169	Pd	<0.0169	Mn	2.54		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-12. SPARK SOURCE MASS SPECTROSCOPY SASS 10- AND 3-μm PARTICULATES--TCA SCRUBBER ($\mu g/m^3$*)

U	0.137	Dy	0.205	Rh	0.00683	Cr	4.10
Th	0.137	Tb	0.0683	Ru	<0.0273	V	4.10
Bi	<0.00683	Gd	0.205	Mo	0.683	Ti	68.3
Pb	0.683	Eu	0.0683	Nb	0.410	Sc	1.37
Tl	0.137	Sm	0.273	Zr	4.10	Ca	3,420
Hg	<0.273	Nd	0.683	Y	2.05	K	273
Au	<0.00683	Pr	0.273	Sr	13.7	Cl	6.79
Pt	<0.0273	Ce	1.37	Rb	5.47	S	410
Ir	<0.0273	La	0.683	Br	0.513	P	16.4
Os	<0.0273	Ba	41.0	Se	0.220	Si	820
Re	<0.0273	Cs	0.0615	As	1.03	Al	410
W	<0.0273	I	0.0205	Ge	4.10	Mg	68.3
Ta	<0.137	Te	<0.0273	Ga	2.05	Na	82.0
Hf	<0.0273	Sb	0.164	Zn	13.7	F	0.273
Lu	<0.00683	Sn	0.137	Cu	1.03	B	4.10
Yb	0.0683	In	<0.0205	Ni	0.683	Be	0.137
Tm	0.00683	Cd	<0.205	Co	1.37	Li	1.23
Er	0.0683	Ag	0.205	Fe	205		
Ho	0.0273	Pd	<0.0273	Mn	8.20		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-13. SPARK SOURCE MASS SPECTROSCOPY
SASS 1-µm AND FILTER PARTICULATES--TCA SCRUBBER
($\mu g/m^3$*)

U	10.5	Dy	5.23	Rh	<0.314	Cr	27.1
Th	1.25	Tb	3.14	Ru	<2.09	V	188
Bi	0.418	Gd	5.23	Mo	26.1	Ti	520
Pb	1.80	Eu	1.57	Nb	0.674	Sc	10.4
Tl	6.27	Sm	4.18	Zr	10.5	Ca	5,150
Hg	<2.09	Nd	15.4	Y	20.9	K	23.7
Au	<0.732	Pr	6.21	Sr	41.6	Cl	†
Pt	0.627	Ce	10.4	Rb	4.12	S	15,600
Ir	<0.105	La	10.5	Br	†	P	624
Os	<0.209	Ba	623	Se	27.9	Si	449
Re	<0.105	Cs	0.784	As	52.1	Al	4,660
W	5.23	I	0.157	Ge	6.27	Mg	†
Ta	<0.627	Te	1.05	Ga	10.5	Na	†
Hf	1.57	Sb	1.99	Zn	4.73	F	0.113
Lu	<0.523	Sn	6.06	Cu	18.0	B	156
Yb	1.57	In	0.523	Ni	26.3	Be	2.61
Tm	<0.627	Cd	15.7	Co	5.12	Li	1.55
Er	2.09	Ag	0.627	Fe	7,810		
Ho	0.627	Pd	<1.05	Mn	†		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-14. SPARK SOURCE MASS SPECTROSCOPY
SASS XAD-2 RESIN--TCA SCRUBBER
($\mu g/m^3$*)

U	1.49	Dy	<3.74	Rh	<0.747	Cr	†
Th	†	Tb	<1.25	Ru	<2.49	V	†
Bi	<1.49	Gd	<3.74	Mo	†	Ti	†
Pb	†	Eu	<2.49	Nb	<0.747	Sc	<2.49
Tl	<9.96	Sm	<3.74	Zr	<2.49	Ca	124
Hg	<49.8	Nd	<3.74	Y	<0.747	K	†
Au	<1.49	Pr	†	Sr	†	Cl	<2.49
Pt	124	Ce	0.623	Rb	†	S	†
Ir	<2.49	La	†	Br	†	P	†
Os	<4.98	Ba	†	Se	†	Si	<22.4
Re	<2.49	Cs	<1.12	As	†	Al	†
W	†	I	<1.87	Ge	<2.49	Mg	†
Ta	<12.5	Te	<4.98	Ga	<0.623	Na	†
Hf	<2.49	Sb	<0.747	Zn	†	F	<4.98
Lu	<1.25	Sn	†	Cu	†	B	†
Yb	<3.74	In	<0.374	Ni	†	Be	<0.0249
Tm	<7.47	Cd	<7.47	Co	†	Li	0.745
Er	<3.74	Ag	<0.747	Fe	†		
Ho	<1.25	Pd	<4.98	Mn	†		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Sample value < blank value.

TABLE 6-15. SPARK SOURCE MASS SPECTROSCOPY SASS CONDENSATE AND FIRST IMPINGER--TCA SCRUBBER ($\mu g/m^3$*)

U	<0.184	Dy	<1.10	Rh	<0.184	Cr	44.1
Th	<0.368	Tb	<0.110	Ru	<0.368	V	0.221
Bi	<0.184	Gd	<0.368	Mo	9.19	Ti	27.6
Pb	0.736	Eu	<0.368	Nb	<0.0736	Sc	<0.736
Tl	<1.47	Sm	<0.368	Zr	<0.184	Ca	73.4
Hg	<7.36	Nd	<0.736	Y	<0.0736	K	29.4
Au	<0.368	Pr	<1.10	Sr	0.221	Cl	22,400
Pt	<0.368	Ce	<0.0552	Rb	0.0588	S	478
Ir	<0.368	La	22.1	Br	3.68	P	44.1
Os	<0.736	Ba	2.57	Se	8.50	Si	7.72
Re	<0.368	Cs	<0.0552	As	<0.0552	Al	61.8
W	<0.368	I	0.827	Ge	<0.736	Mg	3.68
Ta	<1.84	Te	<0.368	Ga	<0.184	Na	12,100
Hf	<0.368	Sb	<0.110	Zn	3.68	F	<3.68
Lu	<0.184	Sn	0.368	Cu	7.36	B	22.0
Yb	<0.368	In	<0.0552	Ni	27.6	Be	<0.00368
Tm	<1.10	Cd	<1.10	Co	0.368	Li	0.0331
Er	<0.368	Ag	0.331	Fe	187		
Ho	<0.368	Pd	<0.736	Mn	13.2		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-16. SPARK SOURCE MASS SPECTROSCOPY
VENTURI FILTER CAKE
(μg/g*)

U	1.30	Dy	3.90	Rh	<0.390	Cr	39.0
Th	5.20	Tb	1.30	Ru	<0.650	V	39.0
Bi	<0.260	Gd	6.50	Mo	4.55	Ti	1,950
Pb	2.60	Eu	3.90	Nb	3.90	Sc	39.0
Tl	2.60	Sm	13.0	Zr	65.0	Ca	390,000
Hg	<3.90	Nd	39.0	Y	39.0	K	2,600
Au	<0.130	Pr	13.0	Sr	130	Cl	386
Pt	<0.390	Ce	32.5	Rb	13.0	S	65,000
Ir	<0.260	La	26.0	Br	3.25	P	260
Os	<0.260	Ba	650	Se	<0.910	Si	78,000
Re	<0.260	Cs	1.37	As	19.5	Al	78,000
W	0.390	I	<1.37	Ge	26.0	Mg	650
Ta	<0.650	Te	<0.390	Ga	6.50	Na	194
Hf	<0.650	Sb	0.780	Zn	13.0	F	78.0
Lu	<0.130	Sn	2.60	Cu	19.5	B	77.9
Yb	2.60	In	<0.0650	Ni	195	Be	1.30
Tm	0.390	Cd	<1.17	Co	65.0	Li	7.80
Er	2.60	Ag	<0.0780	Fe	19,500		
Ho	0.650	Pd	<1.30	Mn	38.9		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-17. SPARK SOURCE MASS SPECTROSCOPY VENTURI SPRAY TOWER SLURRY--SOLIDS (μg/g*)

U	2.60	Dy	2.60	Rh	<0.130	Cr	11.7
Th	2.60	Tb	1.30	Ru	<0.390	V	39.0
Bi	<0.130	Gd	3.90	Mo	13.0	Ti	1,300
Pb	2.60	Eu	0.390	Nb	2.90	Sc	<39.0
Tl	2.60	Sm	6.50	Zr	26.0	Ca	780,000
Hg	<3.90	Nd	26.0	Y	13.0	K	2,600
Au	<0.130	Pr	13.0	Sr	130	Cl	26,000
Pt	<0.390	Ce	32.5	Rb	26.0	S	260,000
Ir	<0.390	La	13.0	Br	975	P	104
Os	<0.390	Ba	390	Se	20.9	Si	19,500
Re	<0.650	Cs	1.95	As	195	Al	11,700
W	0.650	I	<0.975	Ge	65.0	Mg	260
Ta	<1.30	Te	<0.390	Ga	6.50	Na	77.2
Hf	<0.390	Sb	1.56	Zn	260	F	260
Lu	<0.130	Sn	2.60	Cu	195	B	117
Yb	0.390	In	<0.325	Ni	32.5	Be	1.30
Tm	0.130	Cd	<3.90	Co	19.5	Li	3.90
Er	1.30	Ag	<0.0780	Fe	3,900		
Ho	0.130	Pd	<0.390	Mn	195		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-18. SPARK SOURCE MASS SPECTROSCOPY VENTURI SPRAY TOWER SLURRY--LIQUID (μg/L*)

U	<15.5	Dy	<31.0	Rh	<15.5	Cr	65.0
Th	<31.0	Tb	<15.5	Ru	<92.9	V	92.9
Bi	<15.5	Gd	<92.9	Mo	4,640	Ti	1,080
Pb	31.0	Eu	<31.0	Nb	<15.5	Sc	<61.9
Tl	<310	Sm	<31.0	Zr	<15.5	Ca	11,600,000
Hg	<619	Nd	<61.9	Y	<9.29	K	774,000
Au	<31.0	Pr	<15.5	Sr	16,100	Cl	7,740,000
Pt	<61.9	Ce	<7.74	Rb	1,860	S	5,570,000
Ir	<61.9	La	<92.9	Br	209,000	P	12.4
Os	<61.9	Ba	9,290	Se	<433	Si	92,400
Re	<92.9	Cs	<13.9	As	<3,100†	Al	10,100
W	<31.0	I	9,240	Ge	3,100	Mg	1,240,000
Ta	<92.9	Te	<61.9	Ga	<15.5	Na	158,000
Hf	<92.9	Sb	<92.9	Zn	3,100	F	8,670
Lu	<15.5	Sn	<92.9	Cu	310	B	111,000
Yb	<31.0	In	<46.4	Ni	310	Be	31.0
Tm	<31.0	Cd	<929	Co	310	Li	1,300
Er	<31.0	Ag	<18.6	Fe	83.6		
Ho	<15.5	Pd	<61.9	Mn	20,400		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

†Interference from calcium chloride.

TABLE 6-19. SPARK SOURCE MASS SPECTROSCOPY TCA CENTRIFUGE CAKE (μg/g*)

U	2.60	Dy	3.90	Rh	<0.130	Cr	39.0
Th	5.20	Tb	1.30	Ru	<0.390	V	39.0
Bi	<0.260	Gd	6.50	Mo	4.55	Ti	1,950
Pb	2.60	Eu	2.60	Nb	6.50	Sc	39.0
Tl	2.60	Sm	13.0	Zr	65.0	Ca	390,000
Hg	<3.90	Nd	65.0	Y	39.0	K	2,600
Au	<0.130	Pr	26.0	Sr	130	Cl	646
Pt	<0.390	Ce	45.5	Rb	13.0	S	39,000
Ir	<0.260	La	91.0	Br	32.5	P	104
Os	<0.260	Ba	650	Se	<1.82	Si	78,000
Re	<0.260	Cs	0.390	As	19.5	Al	78,000
W	0.390	I	<0.975	Ge	6.50	Mg	260
Ta	<0.650	Te	<0.390	Ga	6.50	Na	116
Hf	<0.390	Sb	0.780	Zn	13.0	F	78.0
Lu	<0.130	Sn	1.30	Cu	32.5	B	19.4
Yb	2.60	In	<0.0650	Ni	195	Be	0.650
Tm	0.130	Cd	<1.17	Co	13.0	Li	1.95
Er	3.90	Ag	<0.0780	Fe	19,500		
Ho	1.30	Pd	<0.650	Mn	38.9		

*Data available for uncorrected sample values and carbon blank values on each element analyzed.

TABLE 6-20. SUMMARY OF SASS SAMPLING DATA

		Venturi Scrubber	Oxidation Tank Vent	TCA Scrubber
Date of Test		1/29/79 1/30/79	1/31/79	2/2/79
Test Period, Hrs (CST)		1342-0122	1030-1615	0915-2005
Sampling Duration, min		315	305	285
Sample volume, dscm		30.906	32.874	30.410
Avg sampling rate, dscm/min		0.098	0.108	0.107
Probe Temperature, C -	Avg	197	161	201
	Max	205	195	207
	Min	192	151	197
Oven Temperature, C -	Avg	205	202	204
	Max	208	207	205
	Min	199	197	199
Gas Outlet of Condenser, C -	Avg	18	11	16
	Max	25	13	23
	Min	9	3	3
Gas Outlet of Impingers, C -	Avg	12	11	14
	Max	24	15	23
	Min	6	5	6
Percent isokinetic sampling rate		82.8	518	77.3
Filters required/test		8	1	8

TABLE 6-21. SUMMARY OF STACK GAS CONDITIONS DURING SASS TESTS(a)

Flue Gas Parameter	Venturi Scrubber Outlet	Oxidation Tank Vent	TCA Scrubber Outlet
Avg. gas temperature, C	110	39	109
Static Pressure, mm Hg below atmospheric	62.6	0	46.7
O_2, % by volume, dry(b)	8.2	13.8	9.0
CO_2, % by volume, dry(b)	13.7	9.5	13.0
Avg. SO_2 concentration, mg/m^3(c)	245	152	504
Moisture, % by volume(d)	12.3	6.9	10.6
Molecular weight, g/g mole (dry)	30.5	30.1	30.4
Avg. velocity, m/s (stack cond.)	24.99	3.11	27.86
Avg. volumetric flow, m^3/hr (std, dry)	45504	180	53063

(a) Measured at scrubber outlets and vent line from oxidation tank.
(b) Determined by Level 1 on-site GC measurements
(d) Determined from SASS runs.
(c) Obtained from TVA continuous monitor readings. Data reported under oxidation tank vent is for venturi scrubber outlet during the period the vent was sampled.

TABLE 6-22. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi scrubber outler Sample Acquisition Date 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 Sample ID Number SSP-BCL-PR-VSS-1

Sample Description SASS probe + cyclone rinse

Original Sample Volume or Mass 0.3581g

Responsible Analyst R. L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate Column Temperature

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M³
Total Sample[1]	--	2.98	2.98	0.10
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M³
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-23. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi scrubber outlet Sample Acquisition Date 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 Sample ID Number SSP-BCL-10C-VSS-1

Sample Description SASS 10 + 3 um cyclone particulate extract

Original Sample Volume or Mass 0.4912g

Responsible Analyst R. L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate Column Temperature

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M³
Total Sample[1]	--	65.8	65.8	2.13
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M³
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-24. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi scrubber outlet Sample Acquisition Date 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 Sample ID Number SSP-BCL-1C-VSS-1 SSP-BCL-PF-VSS-1

Sample Description SASS 1 μm cyclone + filter extract

Original Sample Volume or Mass 1.0940g

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

- -

Column Flow Rate ~1 ml/min Column Temperature ~17C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]		92.68	92.68	3.00
Taken for LC[2]		40.52	40.52	3.00
Recovered[3]		37.68	37.68	2.79

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1				4.70	.01	4.69	10.73	0.34
2				.01	.02	0.00	0.00	0.00
3				.26	.02	.24	0.55	0.02
4				.06	.07	0.00	0.00	0.00
5				.07	.02	.05	0.11	0.01
6				8.41	.05	8.36	19.12	0.62
7				24.36	.02	24.34	55.67	1.80
Sum				37.87	.21	37.68	86.18	2.79

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-25. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi scrubber outlet Sample Acquisition Date 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 Sample ID Number SSP-BCL-XR-VSS-1
SSP-BCL-MR-VSS-1

Sample Description SASS XAD-2 extract + module rinse

Original Sample Volume or Mass 148 g XAD-2 + 320 ml module rinse

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate ~1 ml/min Column Temperature ~16C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]				1.37
Taken for LC[2]				1.37
Recovered[3]			16.11	0.60

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1	.02	.07	0.00	.25	1.43	0.00	0.00	0.00
2	0.00	0.00	0.00	.29	.09	.20	.20	0.01
3	0.00	0.00	0.00	.61	.37	.24	.24	0.01
4	0.00	0.07	0.00	.66	.19	.47	.47	0.02
5	0.00	0.01	0.00	.37	.19	.18	.18	0.01
6	3.68	.17	3.51	13.46	1.98	11.48	14.99	0.54
7	.03	0.00	.03	.36	1.93	0.00	.03	0.01
Sum	3.73	0.32	3.54			12.57	16.11	0.60

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-26. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi scrubber outlet **Sample Acquisition Date** 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 **Sample ID Number** SSP-BCL-CD/LE-VSS-1

Sample Description SASS Condensate Extract

Original Sample Volume or Mass 220 ml

Responsible Analyst R.L. Barbour **Date Analyzed** -

Calculations and Report Reviewed By J. Howes **Report Date** 4/9/79

- -

Column Flow Rate ~1 ml/min **Column Temperature** ~16C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]	.7	1.98	2.68	0.09
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-27. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/oxidation tank vent **Sample Acquisition Date** 1/31/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-OTV-2 **Sample ID Number** SSP-BCL-PF-OTV-2

Sample Description SASS Filter extract

Original Sample Volume or Mass 0.0012g

Responsible Analyst R.L. Barbour **Date Analyzed** -

Calculations and Report Reviewed By J. Howes **Report Date** 4/9/79

Column Flow Rate **Column Temperature**

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]	—	16.24	16.24	0.49
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-28. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/oxidation tank vent Sample Acquisition Date 1/31/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-OTV-2 Sample ID Number SSP-BCL-XR-OTV-2
SSP-BCL-MR-OTV-2

Sample Description SASS XAD-2 extract + module rinse

Original Sample Volume or Mass 148 g XAD-2 + total sample

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

- -

Column Flow Rate ~1 ml/min Column Temperature ~16C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]				1.49
Taken for LC[2]				1.49
Recovered[3]				1.10

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1	.15	.07	.08	6.45	1.43	5.02	5.10	0.17
2	0.00	0.00		.32	.09	.23	.23	0.10
3	0.00	0.00		1.32	.37	.95	.95	0.03
4	0.00	.07		.65	.19	.46	.46	0.02
5	0.00	.01		.46	.19	.27	.27	0.01
6	.62	.17	.45	7.93	1.97	5.96	6.41	0.22
7	0.00	0.00		18.12	1.93	16.19	16.19	0.55
Sum	.77	0.32	.53	35.25	6.17	29.08	29.61	1.10

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-29. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/oxidation tank vent Sample Acquisition Date 1/31/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-OTV-2 Sample ID Number SSP-BCL-CD/LE-OTV-2

Sample Description SASS condensate extract

Original Sample Volume or Mass 160 ml

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate Column Temperature

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]	--	1.12	1.12	0.03
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-30. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/TCA scrubber outlet Sample Acquisition Date 2/2/79

Type of Source Coal-fired power plant w/venturi scurbber

Test Number SSP-BCL-TCAS-3 Sample ID Number SSP-BCL-PR-TCAS-3

Sample Description SASS probe + cyclone rinse

Original Sample Volume or Mass 0.3600g

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate Column Temperature

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]	--	4.01	4.01	0.13
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-31. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/TCA scrubber outlet Sample Acquisition Date 2/2/79

Type of Source Coal-fired power plant w/TCA scrubber

Test Number SSP-BCL-TCAS-3 Sample ID Number SSP-BCL-10C-TCAS-3
SSP-BCL-3C-TCAS-3

Sample Description SASS 10 + 3 μm cyclone particulate extract

Original Sample Volume or Mass 0.4155g

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate Column Temperature

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]	—	30.85	30.85	1.01
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-32. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/TCA scrubber outlet Sample Acquisition Date 1/29/79

Type of Source Coal-fired power plant w/TCA scrubber

Test Number SSP-BCL-TCAS-3 Sample ID Number SSP-BCL-1C-TCAS-3
SSP-BCL-PF-TCAS-3

Sample Description SASS 1 μm cyclone + filter extract

Original Sample Volume or Mass 1.5866 g

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 2/9/79

- -

Column Flow Rate ~1 ml/min Column Temperature ~16C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]		38.89	38.81	1.28
Taken for LC[2]				1.28
Recovered[3]				1.41

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1				.62	.01	.61	0.95	0.03
2				.05	.02	.03	0.05	0.01
3				.10	.02	.08	0.12	0.01
4				.10	.07	.03	0.05	0.01
5				.10	.02	.08	0.12	0.01
6				18.88	.05	18.83	29.19	0.96
7				7.50	.02	7.48	11.60	0.38
Sum				27.35	0.21	27.14	42.08	1.41

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-33. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/TCA Scrubber outlet **Sample Acquisition Date** 2/2/79

Type of Source Coal-fired power plant w/TCA scrubber

Test Number SSP-BCL-TCAS-3 **Sample ID Number** SSP-BCL-MR-TCAS-3
SSP-BCL-XR-TCAS-3

Sample Description SASS XAD-2 extract + module rinse

Original Sample Volume or Mass

Responsible Analyst R.L. Barbour **Date Analyzed**

Calculations and Report Reviewed By J. Howes **Report Date** 4/9/79

- -

Column Flow Rate ~1 ml/min **Column Temperature** ~16C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]				1.15
Taken for LC[2]				1.15
Recovered[3]				0.41

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1	0.00	.07	0.00	2.64	1.43	1.21	1.28	0.05
2	0.00	0.00	0.00	.13	.09	.04	.04	0.01
3	.08	0.00	.08	.70	.37	.33	.41	0.02
4	.06	.07	0.00	.35	.19	.16	.16	0.01
5	.04	.01	.03	.50	.19	.31	.34	0.01
6	2.92	.17	2.75	6.50	1.97	4.53	7.28	0.27
7	.11	0.00	.11	2.79	1.93	.86	.97	0.04
Sum	3.21	0.32	2.97	13.61	6.17	7.44	10.41	0.41

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-34. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/TCA scrubber outlet Sample Acquisition Date 2/2/79

Type of Source Coal-fired power plant w/TCA scrubber

Test Number SSP-BCL-TCAS-3 Sample ID Number SSP-BCL-CD/LE-TCAS-3

Sample Description SASS condensate extract

Original Sample Volume or Mass 460 ml

Responsible Analyst R.L. Barbour Date Analyzed

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate Column Temperature

Observations no LC

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/M^3
Total Sample[1]	1.0	1.93	2.93	0.10
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-35. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi sludge filter Sample Acquisition Date 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 Sample ID Number SSP-BCL-FC

Sample Description Venturi filter cake extract

Original Sample Volume or Mass 1Kg

Responsible Analyst R.L. Barbour Date Analyzed -

Calculations and Report Reviewed By J. Howes Report Date 4/9/79

Column Flow Rate ~1 ml/min Column Temperature 15C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] Mg/Kg
Total Sample[1]	0.2	15.62	15.82	15.82
Taken for LC[2]	0.18	14.06	14.24	15.82
Recovered[3]	.07	10.57	10.64	11.82

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/Kg
	Total	Blank	Corrected	Total	Blank	Corrected		
1	.01	--		1.08	.01	1.07	1.08	1.20
2	--	--		.08	.02	.06	.06	0.06
3	--	--		.68	.02	.66	.66	0.73
4	--	--		.66	.07	.59	.59	0.66
5	--	--		.59	.02	.57	.57	0.63
6	.06	--		5.25	.05	5.20	5.26	5.84
7	--	--		2.44	.02	2.42	2.42	2.69
Sum	.07					10.57	10.64	11.82

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-36. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/venturi spray tower **Sample Acquisition Date** 1/29/79

Type of Source Coal-fired power plant w/venturi scrubber (adipic acid)

Test Number SSP-BCL-VSS-1 **Sample ID Number** SSP-BCL-VSTS

Sample Description Venturi spray tower slurry extract

Original Sample Volume or Mass 10 liters

Responsible Analyst R.L. Barbour **Date Analyzed**

Calculations and Report Reviewed By J. Howes **Report Date** 4/9/79

- -

Column Flow Rate ~1 ml/min **Column Temperature** 15C

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] mg/L
Total Sample[1]	5.9	33.82	39.72	3.972
Taken for LC[2]	5.3	30.44	35.75	3.972
Recovered[3]	3.24	18.84	22.08	2.453

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/L
	Total	Blank	Corrected	Total	Blank	Corrected		
1	--	--		8.72	.01	8.71	8.71	0.968
2	--	--		.68	.02	.66	.66	0.073
3	--	--		.41	.02	.39	.39	0.043
4	--	--		1.22	.07	1.15	1.15	0.128
5	--	--		1.20	.02	1.18	1.18	0.131
6	2.90	--		5.35	.05	5.30	8.20	0.911
7	.34	--		1.47	.02	1.45	1.79	0.199
Sum	3.24			19.05		18.84	22.08	2.453

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-37. LC ANALYSIS REPORT

Contractor BCL

Sample Site Shawnee/TCA sludge centrifuge **Sample Acquisition Date** 2/2/79

Type of Source Coal-fired power plant w/TCA scrubber

Test Number SSP-BCL-TCAS-3 **Sample ID Number** SSP-BCL-CC

Sample Description TCA centirfuge cake extract

Original Sample Volume or Mass 1 Kg

Responsible Analyst R.L. Barbour **Date Analyzed** -

Calculations and Report Reviewed By **Report Date** 4/9/79

- -

Column Flow Rate **Column Temperature**

Observations

	TCO mg	GRAV mg	Total mg	Concentration[5] Mg/Kg
Total Sample[1]	.1	9.57	9.67	9.67
Taken for LC[2]				
Recovered[3]				

Fraction	TCO[4] in mg			GRAV[4] in mg			Total[4] mg	Concentration[5] mg/M^3
	Total	Blank	Corrected	Total	Blank	Corrected		
1								
2								
3								
4								
5								
6								
7								
Sum								

1. Quantity in entire sample, determined before LC
2. Portion of whole sample used for LC, actual mg
3. Quantity recovered from LC column, actual mg
4. Total mg computed back to total sample
5. Total mg divided by total volume

TABLE 6-38

IR REPORT

SAMPLE: Unfractionated Sample of SASS Probe and Cyclone Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2970, 2938, 2865	S	CH_2, CH_3 stretch	
1745	W	C=O stretch	
1730	W	C=O stretch	shoulder
1465	M	CH_2 bend	
1385	W	CH_3 bend	
735	W	$-(CH_2)_n-$	

Predominately aliphatic hydrocarbon. Small amounts of two carbonyl containing compounds, probably ester and acid.

TABLE 6-39

IR REPORT

SAMPLE: Unfractionated SASS 10 + 3 μm Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3370	S	O-H stretch	broad
2920, 2855, 2878	S	C-H stretch, CH_2&CH_3	
1735	M	C=O	
1715	M	C=O	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1355	W		DEG*
1285	W	C-O stretch	DEG*
1260	W	C-O stretch	
1240	W	C-O stretch	
1130	M	DEG*	
1075	M	DEG*	shoulder
1060	M	DEG*	
920	W	DEG*	shoulder
900	W	DEG*	

*Diethylene glycol

Predominately diethylene glycol with two carbonyl containing compounds which are probably aliphatic acid and aliphatic unsaturated ester. The relative intensities of the saturated C-H bands indicates that some aliphatic hydrocarbon is also present.

TABLE 6-40

IR REPORT

SAMPLE: Unfractionated SASS 1 µm + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3450	S	O-H stretch	broad
2950, 2920,	W	CH_2, CH_3 stretches	
2895, 2885			
1730	W	C=O stretch	
1650	W	O-H	H_2O
1480	W	CH_2 bend	
1355	W	DEG*	
1295	W	C-O stretch	
1130	W	DEG	
1075	W	DEG	
1055	W	DEG	
920	W	DEG	shoulder
900	W	DEG	
*Diethylene glycol			

Diethylene glycol is the major component. A small amount of a carbonyl containing compound is present, but not identifiable.

TABLE 6-41

IR REPORT

SAMPLE: LC Fraction #1 of SASS 1µ + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2927, 2858	S	CH_2, CH_3 stretch	
1465	M	CH_2 bend	
1380	W	CH_3 bend	
1200	M	PCFE*	
1152	W	PCFE*	
1130	M	PCFE*	
1041	W	PCFE*	
970	M	PCFE*	
901	M	PCFE*	
600	M	PCFE*	
*polychlorolrifluoroethylene			

Aliphatic hydrocarbon, with a high content of polychlorotrifluoroethylene.

IR REPORT

TABLE 6-42

SAMPLE: LC Fraction #2 of SASS 1 um + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments

Aliphatic CH and ester carbonyl at levels below normal background contamination.

IR REPORT

TABLE 6-43

SAMPLE: LC Fraction #3 of SASS 1 um + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2880	S	CH_3 stretch	
2925, 2850	S	CH_2 stretch	
1735	M	C=O stretch	
1600	W	C=C stretch	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1265	W	C-O stretch, $Si-CH_3$	
1180	W	-	
1110	W	Si-O	
1020	W	Si-O	
800	W	aromatic substitution, $Si(CH_3)_2$	
750	W	aromatic substitution, $Si(CH_3)_2$	
700	W	aromatic substitution, $Si(CH_3)_2$	

Predominately aliphatic hydrocarbon, with some aliphatic ester and aromaticity as well as a small amount of silicone. Intensities are just over normal background.

TABLE 6-44

IR REPORT

SAMPLE: LC Fraction #4 of 1 μm + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2927, 2852	S	CH_2, CH_3 stretch	
1738	M	C=O stretch	
1460	M	CH_2 bend	
1440	M		shoulder
1380	W	CH_3 bend	
1330, 1340	W	-	
1250, 1260	W	C-O stretch, $Si-(CH_3)_2$	
1170	W	-	
1100	W	Si-O	
1045	W	-	
1015	W	Si-O	

Mainly aliphatic hydrocarbon with a carbonyl which is probably an aliphatic ester and possibly a small quantity of silicone compound. There is very little material present over normal background.

TABLE 6-45

IR REPORT

SAMPLE: LC Fraction #5 of 1 μm + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2927, 2852	S	CH_2, CH_3 stretch	
1730	S	C=O stretch	
1600	W	C=C stretch, aromatic	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1282	S	C-O stretch	
1265	S	C-O stretch	
1165	W	-	
1125	M	phthalate	
1075	M	phthalate	
1040	W	phthalate	
1015	W	-	
810	W	-	

Predominately phthalate ester with another aromatic ester. Intensity of C-H bands suggests that the esters have a high aliphatic hydrocarbon content.

TABLE 6-46

IR REPORT

SAMPLE: LC Fraction #6 of 1 um + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3370	S	O-H stretch	broad
2960, 2872	S	CH_3 stretch	
2921, 2855	S	CH_2 stretch	
1950	W	DEG *	
1730	S	C=O stretch	
1600	W	C=C stretch	aromatic
1460	M	CH_2 bend	
1381	W	CH_3 bend	
1358	W	DEG	
1285	S	C-O stretch	
1265	S	C-O stretch	shoulder
1128	S	DEG	
1075	S	DEG	
920	S	DEG	shoulder
900	S	DEG	
810	W	DEG	
742	M	aromatic substitution	
710	W	aromatic substitution	
*Diethylene glycol			

Diethylene glycol and aromatic ester, probably phthalate.

TABLE 6-47

IR REPORT

SAMPLE: LC Fraction #7 of 1 um + Filter Particulate Extract - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3350	S	O-H stretch	
2920, 2872, 2860	S	CH_2, CH_3 stretch, aliphatic	
1950	W	DEG*	
1728	M	C=O	
1460	M	CH_2 bend	
1420	W	-	
1358	M	CH_3 bend	
1325	W	-	
1290	W	C-O stretch	
1230	W	DEG	
1130	S	DEG	
1080	S	DEG	shoulder
1060	S	DEG	
920	M	DEG	shoulder
900	M	DEG	
815	W	DEG	
*Diethylene glycol			

Principally diethylene glycol. There is a small amount of ester present.

TABLE 6-48

IR REPORT

SAMPLE: Unfractionated SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3050	M	O-H stretch	broad
2965, 2935, 2860	S	CH_2, CH_3 stretch	
1710	S	C=O stretch	
1460	M	CH_2 bend	
1420	W	O-H bend	
1385	W	CH_3 bend	
1285	M	C-O stretch (acid)	
1265	M	$Si-(CH_3)_2$	
1100	M	Si-O	
1025	W	Si-O	
945	W	O-H out of plane bend	
810	M	$Si-(CH_3)_2$	

The major component is a saturated aliphatic acid. A small amount of silicone compound is also present.

TABLE 6-49

IR REPORT

SAMPLE: LC Fraction #1 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2925, 2854	S	CH_2, CH_3 stretch	
1738	W	C=O stretch	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1265	W	C-O stretch	
1125	W	-	
1072	W	-	
1028	W	-	
965	W	-	
810	W	-	
722	W	$-(CH_2)n-$	

Principally aliphatic hydrocarbon. A small amount of aliphatic ester is present.

TABLE 6-50

IR REPORT

SAMPLE: LC Fraction #2 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments

Aliphatic hydrocarbon and a polysiloxane in concentrations barely higher than normal backround levels.

TABLE 6-51

IR REPORT

SAMPLE: Fraction 3 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2961, 2925, 2852	S	CH_2, CH_3 stretch	
1950	W		
1735	S	C=O stretch	
1632	M	C=C stretch	
1600	W	C=C stretch	
1460	M	CH_2 bend	
1418	W	silicone compound	
1380	W	CH_3 bend	
1265	S	$Si-CH_3$	
1098	S	Si-O	
1022	S	Si-O	
866	M	$Si-(CH_3)_2$ bend	shoulder
802	S	$SiO(CH_3)_2$ bend	
705	M	aromatic substitution	

Predominately silicone compound with some aromatic ester. The intensity of CH suggests a high aliphatic hydrocarbon content, probably as part of the ester.

IR REPORT

TABLE 6-52

SAMPLE: LC Fraction #4 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2927, 2858	S	CH_2, CH_3 stretch	
1735	S	C=O stretch	
1640	M	-	
1605, 1580	W	C-C stretch	
1555	W	-	
1460	M	CH_2 bend	
1375	W	CH_3 bend	
1268	S	C-O stretch	
1177	W	aromatic ester	
1110	M	Si-O	
1022	M	Si-O	
800	M	$Si-(CH_3)_2$	
707	M	aromatic substitution	

Silicone compound and an aromatic ester with high aliphatic content are the major components. A small amount of a third component is present, which may be a salt.

IR REPORT

TABLE 6-53

SAMPLE: LC Fraction #5 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2925, 2855	S	CH_2, CH_3 stretch	
1735	S	C=O stretch, ester	
1638	W	-	
1605	W	C=C	
1560	W	-	
1460	M	CH_2 bend	
1375	W	CH_3 bend	
1265	M	C-O stretch + $Si(CH_3)_2$	
1168	W	aromatic ester	
1115	W	aromatic ester	
1100	W	Si-O	shoulder
1015	W		
1020	W	Si-O	
800	M	$Si-(CH_3)_2$	
710	M	aromatic substitution	

Predominately an aromatic ester, probably a benzoate, with a large aliphatic hydrocarbon content. There is also a small amount of silicone compound and a fourth component, possibly a salt.

IR REPORT

TABLE 6-54

SAMPLE: LC Fraction #6 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2885	S	CH_3 stretch	shoulders
2928, 2858	S	CH_2 stretch	
2500-3200	M	OH stretch, acid	very broad
1705	S	C=O stretch, acid	
1610	W	C=C stretch, aromatic	
1460	M	CH_2 bend	
1418	M	OH bend, acid	
1288	M	C-O stretch	
1180	W	C-O stretch	
1072	W	-	
1030	W	-	
940	W	OH bend	
800	W	aromatic substitution	
718	M	$-(CH_2)n-$	

Predominately long chain saturated aliphatic acid. A small amount of aromatic, probably ester, is present.

IR REPORT

TABLE 6-55

SAMPLE: Fraction #7 of SASS XAD-2 Extract + Module Rinse - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3300	M	O-H stretch	broad
2925, 2880, 2855	S	CH_2, CH_3 stretch	
1735	S	C=O stretch, ester	shoulder
1715	S	C=O stretch, acid	
1630	W		
1605	W	C=C	
1575	W	acid salt	
1560	W	acid salt	
1460	W	CH_2 bend	
1408	M	OH bend	
1360	W	-	
1320	W	-	
1280	M	C-O stretch	shoulder
1267	M	C-O stretch	
1250	M	C-O stretch	shoulder
1178	W	-	
1124	M	phthalate	
1080	M	phthalate	
1060	M	-	
920	W	OH bend	
800	W	-	
720	M	$-(CH_2)n-$	

Predominately aliphatic acid with phthalate ester (either iso or tere phthalate). There is also a small amount of acid salt. Adipic acid is a possible, constitutent.

TABLE 6-56

IR REPORT

SAMPLE: Unfractioned Extract of SASS Condensate - Venturi Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2930,			
2890, 2858	S	CH_2, CH_3 stretch	
1730	M	C=O stretch	
1720	M	C=O stretch	shoulder
1610	W	C=C	aromatic
1465	M	CH_2 bend	
1385	W	CH_3 bend	
1290	M	C-O stretch	
1270	M	Si-CH_3	
1205	W	C-O stretch	
1100	W	Si-O stretch	
1030	W	Si-O stretch	
810	M	Si-$(CH_3)_2$ stretch	

Two carbonyl containing compounds are present, an ester and most likely an acid. Intensity of the CH bands indicates aliphatic hydrocarbon. There is also a very small amount of silicone compound present.

TABLE 6-57

IR REPORT

SAMPLE: Unfractionated Extract of SASS Filter - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3360	S	O-H Stretch	broad
2915, 2875, 2855	S	CH_2, CH_3 Stretch	
1950	W	DEG*	broad
1730	S	C=O stretch	
1462	M	CH_2 bend	
1420	W	CH_2 bend	
1380	W	CH_3	
1355	W	DEG*	
1280	M	C-O stretch	
1270	M	C-O stretch	shoulder
1125	S	DEG*	
1075	S	DEG*	shoulder
1065	S	DEG*	
920	S	DEG*	shoulder
900	S	DEG*	
740	M	$-(CH_2)_n-$	

*Diethylene glycol

Predominately diethylene glycol. A carbonyl containing compound is present which is probably unsaturated aliphatic ester.

TABLE 6-58

IR REPORT

SAMPLE: Unfractioned SASS XAD-2 Extract and Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3150	W	O-H stretch	broad
2960, 2925, 2855	S	CH$_2$, CH$_3$ stretch	
1710	S	C=O stretch	
1460	M	CH$_2$ bend	
1420	W	OH bend	
1380	W	CH$_3$ bend	
1280	W	C-O stretch	
1260	M	Si-CH$_3$ stretch	
1100	M	Si-O stretch	
1025	W	Si-O	
810	M	Si-(CH$_3$)$_2$	

Mostly saturated aliphatic acid with a small quantity of silicone compound.

TABLE 6-59

IR REPORT

SAMPLE: LC Fraction #1 of SASS XAD-2 Extract + Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2927, 2858	S	CH$_2$, CH$_3$ stretch	
1465	M	CH$_2$ bend	
1380	W	CH$_3$ bend	
1200	W	PCFE*	
972	W	PCFE	
727	W	-(CH$_2$)n-	
*Polychlorotrifluoroethylene			

Aliphatic hydrocarbon with a very small amount of polychlorotrifluoro ethylene

TABLE 6-60

IR REPORT

SAMPLE: LC Fraction #2 of SASS XAD-2 Extract + Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2952, 2925, 2855	S	CH_2, CH_3 stretch	
1740	W	C=O stretch	
1600	W	C=C stretch	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1262	W	$Si-(CH_3)_2$	
1100	W	Si-O	
1030	W	Si-O	
802	W	$Si-(CH_3)_2$	

Predominately aliphatic hydrocarbon with small quantities of ester and silicone compound(s). Aromaticity is evident somewhere in the system.

TABLE 6-61

IR REPORT

SAMPLE: LC Fraction #3 of SASS XAD-2 Extract + Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2965, 2927, 2859	S	CH_2, CH_3 stretch	
1738	S	C=O stretch	
1628	M	C=O stretch	
1600	M	C=C stretch	
1459	S	CH_2 bend	
1380	M	CH_3 bend	
1265	S	C-O stretch	
1099	S	Si-O	
1025	S	Si-O	
870	M	$Si-(CH_3)_3$	
804	S	$Si-(CH_3)_2$	
703	M	aromatic substitution	

Largely silicone compound with some aromatic ester and aliphatic hydrocarbon (which) may be at least in part on the ester). There is a fourth component which may be a salt.

TABLE 6-62

IR REPORT

SAMPLE: LC Fraction #4 of SASS XAD-2 Extract + Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2958, 2926, 2855	S	CH_2, CH_3 stretch	
1736	S	C=O stretch	
1600	W	C=C stretch	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1264	M	$Si-(CH_3)_2$	
1175	W	C-O	
1110	W	Si-O	
1021	W	Si-O	
870	W	$Si-(CH_2)_3$	
800	M	$Si-(CH_3)_3$	
710	W	aromatic substitution	

Aromatic ester with high aliphatic hydrocarbon content. Also contains a silicone compound.

TABLE 6-63

IR REPORT

SAMPLE: LC Fraction #5 of SASS XAD-2 Extract - Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2928, 2859	S	CH_2, CH_3 stretch	
1741	S	C=O stretch	
1608	W	C=C stretch	
1460	S	CH_2 bend	
1380	M	CH_3 bend	
1265	M	C-O stretch, $Si-CH_3$	
1170	W	aromatic ester	
1115	W	aromatic ester, Si-O, ether	
1025	W	Si-O	
800	M	$Si-(CH_3)_2$, aromatic substitution	
715	W	aromatic substitution	

Aromatic ester, possibly with some ether-ester compound and a small amount of silicone. There may be some terephthalate.

IR REPORT

TABLE 6-64

SAMPLE: Fraction #6 of SASS XAD-2 Extract + Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2500-3500	M	O-H stretch	very broad
2960, 2930, 2855	S	CH_2, CH_3 stretch	
1735	S	C=O stretch, ester	shoulder
1702	S	C=O stretch, acid	
1610	W	C=C stretch	
1460	M	CH_2 bend	
1418	M	OH, acid	
1385	W	CH_3 bend	
1320	W	-	
1288	S	C-O stretch	
1260	M	C-O stretch	shoulder
1180	W	-	
1120	W	-	
1075	W	-	
1028	W	-	
940	W	OH acid	
800	W	Si-CH_3	
718	S	aromatic substitution	

Mainly saturated aliphatic acid with an aromatic ester, probably benzoate, and a trace of silicone compound.

TABLE 6-65

IR REPORT

SAMPLE: LC Fraction #7 of SASS XAD-2 Extract + Module Rinse - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3300	M	OH stretch	
2960, 2928, 2855	S	CH_2, CH_3 stretch	
1736	S	C=O s-retch	
1595	W	-	
1565	W	-	
1459	W	CH_2 bend	
1412	W		
1378	W	CH_3 bend	
1280	W	C-O stretch	
1255	W	-	
1170	W	-	shoulder
1115	M	ether C-O	
1090	M	-	shoulder
920	W	-	
722	W	-$(CH_2)n$-	

Aliphatic ester and aliphatic ether with at least one other constituent.

TABLE 6-66

IR REPORT

SAMPLE: Unfractionated Extract of SASS Condensate - Oxidation Tank Vent

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2963, 2930,			
2890, 2862	S	CH_2, CH_3 stretch	
1735	W	C=O stretch	
1715	W	C=O stretch	
1650	W	C=C stretch	
1470	M	CH_2 bend	
1380	W	CH_3 bend	
1295	W	C-O stretch	
1270	W	Si-CH_3, C-O	
1100	W	Si-O	
1030	W	Si-O	
810	W	Si-$(CH_3)_2$	

Predominately aliphatic hydrocarbon. Small amounts of 2 carbonyl containing compounds, one of which could be an aromatic ester, and silicone compounds.

TABLE 6-67

IR REPORT

SAMPLE: Unfractionated SASS Probe and Cyclone Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2880	S	CH_3 stretch	
2925, 2855	S	CH_2 stretch	
1740	W	C=O	
1650	W	C=C	
1470	M	CH_2 bend	
1380	W	CH_3 bend	
725	W	$-(CH_2)_n-$	

Aliphatic hydrocarbon with a small amount of ester.

TABLE 6-68

IR REPORT

SAMPLE: Unfractionated Extract of SASS 10 + 3 μm Particulates - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3360	S	O-H stretch	broad
2920, 2850	S	CH_2 stretch	
2878	S	CH_3 stretch	
1940	W	DEG*	broad
1730	M	C=O stretch	shoulder
1712	M	C=O stretch	
1460	M	CH_2 bend	DEG
1420	W	OH bend	
1380	W	CH_3 bend	DEG
1355	W	DEG	
1265	W	C-O	
1240	W	C-O	
1125	S	DEG	
1080	S	DEG	shoulder
1060	S	DEG	
920	M	DEG	shoulder
900	M	DEG	
815	W		
738	M	$-(CH_2)_n-$	
*Diethylene glycol			

Principally diethylene glycol, some unsaturated ester and saturated aliphatic acid.

TABLE 6-69

IR REPORT

SAMPLE: Unfractionated Extract of SASS 1 μm + Filter Particulates - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3450	S	O-H stretch	broad
2950, 2880	S	CH_3 stretch	
2920, 2855	S	CH_2 stretch	
1730	S	C=O stretch	
1720	S	C=O stretch	shoulder
1460	M	CH_2 bend	
1420	W	OH bend	
1380	W	CH_3 bend	
1355	W	DEG*	
1285	W	C-O	
1265	W	C-O	
1125	M	DEG	
1070	M	DEG	
910	M	DEG	
* Diethylene glycol			

A mixture of diethylene glycol and two carbonyl containing compounds which are probably an acid and on ester.

TABLE 6-70

IR REPORT

SAMPLE: Fraction # 1 of SASS 1 um Cyclone + Filter Extract - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2928, 2857	S	CH_2, CH_3 stretch	
1750	W	C=O stretch	
1465	M	CH_2 bend	
1380	W	CH_3 bend	
1202	W	PCFE*	
1128	W	PCFE	
970	W	PCFE	
900	W	PCFE	
725	W	$-(CH_2)n-$	
*Polychlorotrifluoroethylene			

Principally aliphatic hydrocarbon, with a small amount of polychlorotrifluoroethylene.

TABLE 6-71

IR REPORT

SAMPLE: LC Fraction #2 of 1 um + Filter Particulate Extract - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments

Aliphatic hydrocarbon and carbonyl at levels approximating normal background.

IR REPORT

TABLE 6-72

SAMPLE: LC Fraction #3 of SASS 1 μm + Filter Extract - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2961, 2925, 2852	S	CH_2, CH_3 stretch	
1735	M	C=O stretch	
1600	M	C=C stretch	
1460	M	CH_2 bend	
1180	W	-	
1262	S	$Si-(CH_3)_2$	
1100	S	Si-O	
1025	S	Si-O	
805	S	$Si-(CH_3)_2$	

Principally silicone compounds. There are also carbonyl and aliphatic hydrocarbon in the system as well as significant aromaticity.

IR REPORT

TABLE 6-73

SAMPLE: LC Fraction #4 of SASS 1 μm Cyclone + Filter Extract - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2924, 2885, 2853	S	CH_2, CH_3 stretch	
1730	M	C=O stretch	
1462	M	CH_2 bend	
1380	W	CH_3 bend	
1261	W	C-O stretch	
1172	W	-	
1105	W	-	

A carbonyl containing compound with high aliphatic hydrocarbon content. Intensities are barely above normal background.

IR REPORT

TABLE 6-74

SAMPLE: LC Fraction #5 of SASS 1 μm Cyclone Filter Extract - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2960, 2928, 2852	S	CH_2, CH_3 stretch	
1732	S	C=O stretch	
1600	W	C=C stretch	
1460	M	CH_2 bend	
1380	W	CH_3 bend	
1280	M	C-O stretch	
1268	M	C-O stretch	
1160, 1172	W	-	
1120	W	phthalate	
1075	W	phthalate	
1030	W	phthalate	

An ester, probably phthalate, with high aliphatic hydrocarbon content. There is at least one other unidentified component. Intensities are not greatly over normal

IR REPORT

TABLE 6-75

SAMPLE: LC Fraction #6 of SASS 1 μm Cyclone + Filter-TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3350	M	OH stretch	broad
3061	W	aromatic CH stretch	
2960, 2921, 2852	S	CH_2, CH_3 stretch	
1730	S	C=O stretch	
1605	M	C=C stretch, aromatic	
1587	M	C=C stretch, aromatic	
1462	S	CH_2 bend	
1383	M	CH_2 bend	
1285	S	C-O stretch	
1270	S	C-O stretch	shoulder
1125	S	phthalate ester	
1073	S	phthalate ester	
1040	W	phthalate ester	
1015	W		
966	W	phthalate ester	
941	M	phthalate ester	
841	W	-	
799	W	-	
742	M	phthalate ester	
706	W	phthalate ester	
655	W	phthalate ester	

Predominately phthalate ester with a high aliphatic content. In addition, the shape of the carbonyl with the presence of acid OH and the shoulder at 1270 indicate that an acid is present as well.

IR REPORT

TABLE 6-76

SAMPLE: Unfractionated SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3450	S	O-H stretch	broad
2960, 2880	S	CH_3 stretch	shoulder
2927, 2856	S	CH_2 stretch	
1730	S	C=O	shoulder
1708	S	C=O	
1630	W	C=C	
1610	W	C=C	
1460	M	CH_2 bend	
1420	W	OH bend	
1370	W	CH_3 bend	
1285	M	C-O	
1270	M	C-O	shoulder
1180	W	-	
1115	W	-	
1075	W	-	
1030	W	-	
910	W	O-H bend, acid	

Mainly saturated aliphatic acid, with possibly some ester and aliphatic alcohol.

IR REPORT

TABLE 6-77

SAMPLE: L.C. Fraction #1 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2956, 2856	M		
2926	S	CH_2, CH_3 stretch	
1459	W	CH_2 bend	
1382	W	CH_3 bend	
1260	W	PCFE*	
1196	W	PCFE	
1150	W	PCFE	
1127	W	PCFE	
1104	W	PCFE	
1030	W	PCFE	Broad
965	W	PCFE	
896	W	PCFE	
815	W	-	
725	W	-	
590	W	PCFE	
520	W	-	

*Polychlorotrifluoroethylene

Predominately aliphatic hydrocarbon with a small amount of polychlorotrifluoroethylene.

IR REPORT

TABLE 6-78

SAMPLE: LC Fraction #2 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2950, 2856	M	CH_2, CH_3 stretch	
2926	S		
1745	W	C=O stretch	
1629	W	C=C stretch	
1459	W	CH_2 bend	
1374	W	CH_3 bend	
1258	W	C-O stretch	
1020	W	-	
815	W	-	

Aliphatic hydrocarbon with a small quantity of 2 carbonyl containing compounds which may be acid and ester.

IR REPORT

TABLE 6-79

SAMPLE: LC Fraction #3 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3057, 3026	W	aromatic CH	
2956, 2856	M	aliphatic CH	
2926	S		
1737	W	C=O stretch	
1636	W	-	
1603	W	C=C stretch	
1552	W	-	
1459	W	CH_2 bend	
1382	W	CH_3 bend	
1258	M	$Si-(CH_3)_2$	
1088	M	Si-O	
1019	M	Si-O	
865	W	$Si-(CH_3)_3$	
803	M	$Si-(CH_3)_2$	
756	W	aromatic substitution	
702	W	aromatic substitution	

Largely silicone compound(s). There is both aromatic and aliphatic character in the system as well as a small amount of carbonyl containing compound, probably an aliphatic ester.

IR REPORT

TABLE 6-80

SAMPLE: LC Fraction #4 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2950, 2856	M	CH_2, CH_3 stretch	
2926	S		
1737	M	C=O stretch	
1636	W		
1606	W	C=C stretch	
1559	W		
1459	W	CH_2 bend	
1374	W	CH_3 bend	
1266	W	C-O stretch	
1173	W	-	
1112	W	Si-O	
1027	W	Si-O	
903	W		
803	W	Si-CH_3	
757	W		
710	W	aromatic substitution	

Saturated aliphatic ester and an aromatic compound with some silicone compound(s). There is an unidentified component seen in the bands at 1559 and 1636

IR REPORT

TABLE 6-81

SAMPLE: LC Fraction #5 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2950, 2856	M		
2924	S	CH_2, CH_3 stretch	
1729	M	C=O, ester	
1636	W	acid salt	
1606	W	C=C	
1559	W	acid salt	
1490	W		shoulder
1459	W	CH_2 bend	
1374	W	CH_3 bend	
1274	M	C-O stretch	
1173	W	aromatic ester	
1158			
1112	W	aromatic ester	
1073			
1050	W	aromatic ester	
1027		Aromatic ester	
980	W	-	
802	W	-	
756	W	-	
710	W	aromatic substitution	
417	W	-	

High degree of aliphatic character with an aromatic ester, likely a benzoate, and another unidentified component indicated by bands in the 1500-1700 cm^{-1} region.

IR REPORT

TABLE 6-82

SAMPLE: LC Fraction #6 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2856	M	CH_2, CH_3 stretch	
2926	S		
2500-3200	W	acid OH stretch	very broad
1730	M	C=O stretch, ester	
1706	M	C=O stretch, acid	
1606	W	C=C stretch	
1559	W	-	
1459	M	CH_2 bend	
1413	W		
1382	@	CH_3 bend	
1281	M	C-O stretch	
1173	W		
1119	W	phthalate	
1073	W	phthalate	
1027	W	-	
942	W	OH bend, acid	
865	W	-	
795	W	-	
710	W	aromatic substitution	
648	W	-	

Aliphatic acid and phthalate ester with a minor third component.

IR REPORT

TABLE 6-83

SAMPLE: LC Fraction #7 of SASS XAD-2 Extract + Module Rinse - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3250	W	O-H stretch	broad
3064	W	CH stretch, aromatic	
2969, 2856	m	CH_2, CH_3 stretch, aliphatic	
2926	S		
2500	W	acid OH	broad
1730	S	C=O stretch, ester	
1706	S	C=O stretch	
1606	M	C=C stretch	
1583, 1567	W	C=C stretch	
1451	M	CH_2 bend	
1413	M	OH bend, acid	
1380	M	CH_3 bend	
1320	W		
1281	M	C-O stretch	
1250	M	C-O stretch	shoulder
1173	W	-	
1112	M	phthalate	
1073	M	phthalate	
1027	W	phthalate	
940	W	acid OH	
919	W	-	
865	W	-	
795	W	-	
718	M	aromatic substitution	
687	W	-	
648	W	-	
533	W	-	

Aliphatic acid and aliphatic ester with a small amount of phthalate ester.

TABLE 6-84

IR REPORT

SAMPLE: Unfractionated Extract of SASS Condensate - TCA Scrubber

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2965, 2890	S	CH_3 stretch	shoulder
2930, 2860	S	CH_2 stretch	
1740	M	C=O stretch	
1610	W	C=C	
1470	W	CH_2 bend	
1385	W	CH_3 bend	
1290	W	C-O	
1270	W	C-O	
730	W	$-(CH_2)_n-$	

Aliphatic hydrocarbon with some unsaturated ester and perhaps some other carbonyl containing compound

TABLE 6-85

IR REPORT

SAMPLE: Unfractionated Extract of Venturi Filter Cake

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2925, 2855	S	CH_2 stretch	
1738	M	C=O stretch, ester	shoulder
1710	S	C=O stretch, acid	
1460	M	CH_2 bend	
1420	W	OH bend, acid	
1380	W	CH_3 bend	
1280	W	C-O stretch	
1250	W	C-O stretch	shoulder
1120	W	-	
1080	W	-	
725	W	$-(CH_2)n-$	

Predominately aliphatic hydrocarbon with some ester and acid. Small amount of 4th constituent also present, seen by the shape of the bands from 1100 to 1300 cm^{-1}.

TABLE 6-86

IR REPORT

SAMPLE: LC Fraction #1 of Venturi Filter Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2956, 2856	M	CH_2, CH_3 stretch	
2926	S		
14	W	CH_2 bend	
1382	W	CH_3 bend	
1258	W	$Si-CH_3$	
1096	W	Si-O	
1027	W	Si-O	
803	W	$Si-CH_3$	
417	W	-	

Aliphatic hydrocarbon with some silicone compound.

IR REPORT

TABLE 6-87

SAMPLE: LC Fraction #2 of Venturi Scrubber Filter Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2856, 2956	M	CH_2, CH_3 stretch	
2926	S		
1745	W	C=O	
1459	M	CH_2 bend	
1374	W	CH_3 bend	
1266	W	C-O stretch	
1011	W		
741	W	aromatic substitution	
702	W	aromatic substitution	
610	W		
575	W		

Aliphatic hydrocarbon and saturated ester at levels approximating normal background.

IR REPORT

TABLE 6-88

SAMPLE: LC Fraction #3 of Venturi Filter Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2856	M	CH_2, CH_3 stretch	
2926	S		
1735	W	C=O stretch	
1697	W	-	
1649	W	-	
1520	W	-	
1460	W	CH_2 bend	
1370	W	CH_3 bend	
1258	W	C-O stretch	
1020	W	-	
860	W	-	
810	W	-	
750	W	-	
670	W	-	

Aliphatic ester and at least one other unidentified compound.

TABLE 6-89

IR REPORT

SAMPLE: LC Fraction #4 of Venturi Filter Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2924, 2852	S	CH_2, CH_3 stretch	
1738	M	C=O stretch	
1710		C=O stretch	
1657	W	-	
1600	W	C=C, aromatic	
1535	W	-	
1460	M	CH_2 bend	
1375	W	CH_3 bend	
1262	W	C-O	
1173	W	C-O	
1112	W	-	
1027	W	-	
753	W	-	
725	W	$-(CH_2)n-$	

Primarily aliphatic hydrocarbon. Some aromatic ester and acid as well as a minor 4th component seen in the bands at 1657 and 1535.

TABLE 6-90

IR REPORT

SAMPLE: LC Fraction #5 of Venturi Filter Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2950, 2926, 2852	S	CH_2, CH_3 stretch	
1732	S	C=O stretch, ester	
1655	W		
1600	W	C=C stretch, aromatic	
1462	M	CH_2 bend	
1380	W	CH_3 bend	
1340	W	-	
1272	M	C-O stretch	
1161	W	-	
1124	W	phthalate ester	
1100	W		
1075	W	phthalate ester	
1039	W	phthalate ester	
744	W	-	
615	W	-	

Phthalate ester with high aliphatic hydrocarbon content and another unidentified component.

IR REPORT

TABLE 6-91

SAMPLE: LC Fraction #6 of Venturi Filter Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2926, 2856	S	CH_2, CH_3 bend	
1740	m	C=O ester	
1714	S	C=O acid	
1644	W		
1459	M	CH_2 bend	
1413	W	-	
1382	W	CH_3 bend	
1274	W	C-O stretch	
1175	W	-	
1119	W	-	
1073	W	-	
1050	W	-	
726	W	-	

Aliphatic acid and aliphatic ester and a minor third component.

IR REPORT

TABLE 6-92

SAMPLE: LC Fraction #7 of Venturi Fitler Cake Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2856	M	CH_2, CH_3 stretch	
2825	S		
1730	M	C=O stretch	
1715	M	C=O stretch	
1465	W	CH_2 bend	
1385	w		
1280	W	C-O stretch	
1250	W	C-O stretch	
1175	W	-	
1110	W	ether	
724	W	$-(CH_2)n-$	

Aliphatic ester, aliphatic acid and some aliphatic ether.

TABLE 6-93

IR REPORT

SAMPLE: Unfractionated Extract of Venturi Spray Tower Slurry

Wave Number (cm^{-1})	Intensity	Assignment	Comments
3500	M	OH	
2960, 2930, 2858	S	CH_2, CH_3 stretch	
1739	M	C=O	
1720	M	C=O	
1485	M	CH_2 bend	
1380	W	CH_3 bend	
1280	W	C-O stretch	
1260	W	C-O stretch	
1170	W	-	
1080	W	-	
1065	W	-	
935	W	OH bend	
740	W	-	

Mainly aliphatic hydrocarbon with some olefinic ester and acid, possibly adipic.

TABLE 6-94

IR REPORT

SAMPLE: LC Fraction #1 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2956	S		
2926	S	CH_2, CH_3	
2856	S		
1459	M	CH_2 bend	
1374	W	CH_3 bend	
1158	W	$C-(CH_3)_2$	
965	W	-CH=CH-	
726	W	$-(CH_2)n-$	

Aliphatic hydrocarbon with some long chain character. There is evidence for a slight amount of unsaturation.

TABLE 6-95

IR REPORT

SAMPLE: LC Fraction #2 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2953, 2922, 2850	S	CH_2, CH_3 stretch	
1460	M	CH_2 bend	
1381	W	CH_3 bend	
1370	W	CH_3 bend	

Aliphatic hydrocarbon, slightly above normal backround. The 1381-1370 doublet indicates the presence of gem dimethyl or tert-butyl end groups.

TABLE 6-96

IR REPORT

SAMPLE: LC Fraction #3 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2955, 2925, 2855	S	CH_3, CH_2 stretch	
1735	W	C=O stretch, ester	
1605	W	C=C stretch, aromatic	
1459	MS	CH_2 bend	
1380, 1360	MS	CH_3 bend	
1295	W	C-O stretch	
1280	W	C-O stretch	
1270	W	Si-CH_3	shoulder
1209	W	–	
1140	W	–	
1099	W	Si-O	
1080	W		shoulder
1052	W		
1041	W		
1022	W	Si-O	
944	W	–	
878	W	Si-$(CH_3)_3$	
850	W	–	
808	M	Si-$(CH_3)_2$, aromatic substitution	
752	W	aromatic substitution	
701	W	aromatic substitution	

Predominately aliphatic in character with at least one ester and significant aromaticity in the system. Silicone compounds are also apparent.

TABLE 6-97

IR REPORT

SAMPLE: LC Fraction #4 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2950, 2925, 2852	S	CH_2,CH_3 stretch	
1734	M	C=O stretch, acid	
1715	W	C=O stretch, ester	
1605	W	C=C stretch, aromatic	
1590	W	C=C stretch, aromatic	
1495	M	CH_2 bend	
1380, 1370	W	CH_3 bend	
1295	W	C-O stretch	
1260	W	C-O stretch	shoulder
1245	W	-	
1112	W	-	
1080	W	-	
1052	W	-	
1028	W	-	
880	W	-	
809	W	-	
750	W	-	
728	W	-	
705	W	-	

Large degree of aliphatic character with an aromatic ester and a saturated aliphatic acid.

TABLE 6-98

IR REPORT

SAMPLE: LC Fraction #5 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2952, 2923, 2854	S	CH_2, CH_3 stretch	
1735	M	C=O	
1710	M	C=O	shoulder
1600	W	C=C, aromatic	
1459	M	CH_2 bend	
1380	W	CH_3 bend	
1370	W	CH_3 bend	shoulder
1280	W	C-O stretch	shoulder
1260	W	C-O stretch	shoulder
1245	W	-	shoulder
1160	W	-	
1110	W	-	
878	W		
752	W	aromatic substitution	
700	W	aromatic substitution	

High degree of aliphatic character with an aromatic ester. Only a small amount of material is present.

TABLE 6-99

IR REPORT

SAMPLE: LC Fraction #6 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2956, 2856	M	CH_2, CH_3 stretch	
2933	S		
1737	S	C=O, stretch	
1644	W	-	
1598	W	C=C stretch	
1582	W	-	
1459	W	CH_2 bend	
1382	W	CH_3 bend	
1281	M	C-O stretch	
1166	W	-	
1127	W	phthalate ester	
1073	W	phthlate ester	
1027	W		
741	W	-	
702	W	-	

Predominately aliphatic ester with some phthalate ester, as well as a small amount of a third unidentified component.

TABLE 6-100

IR REPORT

SAMPLE: LC Fraction #7 of Venturi Spray Tower Slurry Extract

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2950, 2856	M	CH_2, CH_3 stretch	
2925	S		
1737	MS	C=O stretch	
1714	MS	C=O stretch, ester	
1600	W	C=C stretch, acid	
1459	W	CH_2 bend	
1420	W	acid OH	
1382	W	CH_3 bend	
1281	W	C-O stretch	
1250	W	C-O stretch	shoulder
1166	W	-	
1073	W	-	
1034	W	-	
942	W	S/B acid OH	
880	W	-	
841	W	-	
741	W	-	
710	W	-	

Predominately saturated aliphatic ester and saturated aliphatic acid. There is also a small amount of aromaticity in the system.

TABLE 6-101

IR REPORT

SAMPLE: Unfractionated Extract of TCA Centrifuge Cake

Wave Number (cm^{-1})	Intensity	Assignment	Comments
2926, 2855	S	CH_2 stretch	
1739	S	C=O stretch	
1715	S	C=O stretch	
1463	M	CH_2 bend	
1420	W	OH bend, acid	
1380	W	CH_3 bend	
1280	W	C-O stretch	
1260	W	C-O stretch	
1170	W	-	
1120	W	-	
1080	W	-	
940	W	acid	
725	W	$-(CH_2)n-$	

Predominately aliphatic hydrocarbon with an ester and a saturated acid.

TABLE 6-102

LRMS REPORT

SAMPLE: LC Fractions 6 & 7 of SASS 1 μm + Filter Particulate Extract - Venturi Scrubber

Major Categories

Intensity	Category	MW Range
100	esters	

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition
100	Dibutylphthalate	278	$C_{16}H_{22}O_4$
100	Dimethlyphthalane	194	$C_{10}H_{10}O_4$

Other

MS REPORT

TABLE 6-103

SAMPLE: LC Fraction 6 & 7 of SASS XAD-2 + Module Rinse - Venturi Scrubber

Major Categories

Intensity	Category	MW Range
	Esters, aliphatic	

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition
	pentadecanoaic acid, methyl ester	256	$C_{16}H_{32}O_2$
	heptadecanoaic acid, methyl ester	284	$C_{18}H_{36}O_2$

Other

LRMS REPORT

TABLE 6-104

SAMPLE: LC Fractions 6 & 7 of SASS XAD-2 + Module Rinse - Oxidation Tank Vent

Major Categories

Intensity	Category	MW Range
100	esters	

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition
10	methyl pentadecanoate	256	$C_{16}H_{32}O_2$
10	methyl heptadecanoate	284	$C_{18}H_{36}O_2$
10	methyl octadecanoate	298	$C_{19}H_{38}O_2$

Other

LRMS REPORT TABLE 6-105

SAMPLE: LC Fractions 6 & 7 of SASS 1 μm + Filter Particulate Extract - TCA Scrubber

Major Categories

Intensity	Category	MW Range
100	esters	

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition
100	dibutylphthalate	278	$C_{16}H_{22}O_4$
10	methyl heptadecanoate	284	$C_{16}H_{36}O_2$

Other

LRMS REPORT

TABLE 6-106

SAMPLE: LC Fractions 6 & 7 of Venturi Spray Tower Slurry Extract

Major Categories

Intensity	Category	MW Range
100	esters	

Sub-Categories, Specific Compounds

Intensity	Category	m/e	Composition

Other

TABLE 6-107. SASS SAMPLING DATA SHEETS

Plant ~~Shawnee Steam Plant~~
Date January 29 & 30, 1979
Sampling Location Venturi Scrubber Outlet
Source I.D. SSP
Run Number VSS-1
Operator J. Howes & D. Kohler
Ambient Temperature 36 F
Barometric Pressure 30.26 in Hg
Static Pressure, (P_S) -33.5 in H_2O
Filter Number(s) SSP-1, 7,8,9,10,11,12,& 13 (8 filters)

LEAK CHECKS

Pretest: Ambient Temp.
0.007 cfm @-20"
400F
0.005 cfm @-20"
Post test: 400F
0.002 cfm @-20"

Probe Length and Type 36" - 316 SS
Nozzle, I.D. 0.50 in
Assumed Moisture, % 13
XAD-2 Module Number 4100-018
Meter Box Number BCL 33937 **Oven Number** 3070-022
Meter ΔH. 1.65 in H_2O
C Factor
Probe Heater Setting 410 F
Oven Setting 410 F
Reference ΔP 1.6 in H_2O
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 15 MINUTES

Traverse Point Number	Sampling Time, min	Clock Time (24-hr clock) CST	Gas Meter Reading (V_m), ft³	Velocity Head (Δp_s), in. H_2O	Orifice Pressure Differential (ΔH), in H_2O		Stack Temperature (T_s), °F	Dry Gas Meter Temperature		Pump Vacuum in Hg	Oven Temperature °F	Impinger Temperature °F	Sorbent Trap Temperature °F	Probe Temperature °F
					Desired	Actual		Inlet ($T_{m_{in}}$), °F	Outlet ($T_{m_{out}}$), °F					
	0	1342	598.0	1.60	1.65	1.65	226	48	45	-16.5	398	54	56	377
	15	1357	650.7	1.55	1.65	1.65	228	64	52	-19.5	398	69	70	385
	30	1412	702.2	1.60	1.65	1.60	225	74	61	-22	399	76	77	389
	45	1427	750.1	1.45	1.65	1.45	221	75	64	-22	399	68	68	391
	stop	1427	Changed filter/Drained condensate reservoir											
			Leak checked before restarting -- 0.005 cfm @ -20"											
	start	1524	753.0	1.60	1.65	1.65	235	54	56	-16.0	399	47	58	391
	60	1539	804.6	1.60	1.65	1.65	227	66	58	-18	402	53	67	390
	75	1554	853.2	1.60	1.65	1.65	224	74	64	-20	403	57	69	392
	90	1609	901.1	1.60	1.65	1.55	228	80	69	-22	404	64	68	395
	105	1624	947.2	1.60	1.65	1.40	226	77	72	-22	401	54	64	401
	stop	1624	Changed filter/Drained condensate reservoir											
			Leak checked before restarting -- 0.004 cfm @ -20"											
	start	1729	949.4	1.50	1.65	1.65	231	58	61	-16.5	402	44	53	393
	120	1744	1000.6	1.40	1.65	1.60	227	68	61	-18.5	403	48	69	386
	135	1759	1053.2	1.40	1.65	1.60	227	75	65	-21.8	404	51	70	386
	150	1814	1100.6	1.45	1.65	1.45	230	77	68	-22.0	403	53	68	390
	stop*	1814	Changed filter/Drain condensate reservoir											
			Leak checked before restarting -- 0.007 cfm @ -20"											
TOTAL														
AVERAGE														

COMMENTS *Stop at 1814 -- Added 250 g silica gel

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Page 1 of 3

TABLE 6-107. (Continued)

Plant Shawnee Steam Plant
Date January 29 & 30, 1979
Sampling Location Venturi Scrubber Outlet
Source I.D. SSP
Run Number VSS-1 (Continued)
Operator
Ambient Temperature
Barometric Pressure
Static Pressure, (P_S)
Filter Number(s)

LEAK CHECKS

Pretest: Ambient Temp.
________@-20"
400F
________@-20"

Post test: 400F
________@-20"

Probe Length and Type
Nozzle, I.D.
Assumed Moisture, %
XAD-2 Module Number
Meter Box Number Oven Number
Meter ΔH.
C Factor
Probe Heater Setting
Oven Setting
Reference ΔP
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ___ MINUTES

Traverse point number	Sampling time, min	Clock time (24-hr clock) CST	Gas meter reading (V_m), ft³	Velocity head (ΔP_s), in. H_2O	Orifice pressure differential (ΔH), in H_2O		Stack temperature (T_s), °F	Dry gas meter temperature		Pump vacuum in Hg	Oven temperature °F	Impinger temperature °F	Sorbent trap temperature °F	Probe temperature °F
					Desired	Actual		Inlet $(T_{m_{in}})$ °F	Outlet $(T_{m_{out}})$ °F					
	start	1915	1103.8	1.45	1.65	1.65	228	55	58	-17.5	405	54	56	390
	165	1930*	1158.0	1.45	1.65	1.60	227	67	59	-21.0	391	57	70	386
	180	1945	1208.7	1.45	1.65	1.50	226	73	63	-22.0	402	60	70	388
	190	1955	1240.3	1.45	1.65	1.40	230	76	66	-22.0	402	61	70	390
	stop	1955	Changed filter/Drain condensate reservoir/Remove soln from 1st impinger											
			Leak checked before restarting -- 0.002 cfm @-20"											
	start	2046	1244.7	1.45	1.65	1.65	227	55	58	-17	406	45	50	382
	205	2101	1296.2	1.45	1.65	1.65	225	66	58	-20	401	50	68	382
	220	2116	1347.4	1.50	1.65	1.55	229	71	62	-22	401	53	68	374
	230	2126	1380.0	1.50	1.65	1.40	228	73	64	-22	402	54	68	381
	stop	2126	Changed filter/Drain condensate reservoir											
			Leak checked before restarting -- 0.002 cfm @-20"											
	start	2218	1381.7	1.50	1.65	1.65	230	52	56	-17.5	401	43	49	387
	245	2233	1434.0	1.50	1.65	1.65	230	66	57	-21.5	401	46	67	380
	260	2248	1485.5	1.40	1.65	1.40	227	66	61	-22	401	51	68	389
	stop	2248	Changed filter/Drain condensate reservoir											
			Leak checked before restarting -- 0.003 cfm @-20"											
	start	2340	1487.6	1.50	1.65	1.65	238	51	53	-17	405	44	49	382
	275	2355	1540.8	1.45	1.65	1.60	238	65	55	-21.5	398	51	69	385
	290	0010	1592.0	1.45	1.65	1.45	237	66	60	-22	400	53	66	383
TOTAL														
AVERAGE														

COMMENTS * Unit 10 pulverizer out, fuel oil used to maintain load

Page 2 of 3

TABLE 6-107. (Continued)

Plant Shawnee Steam Plant
Date January 29 & 30, 1979
Sampling Location Venturi Scrubber Outlet
Source I.D. SSP
Run Number VSS-1 (Continued)
Operator
Ambient Temperature
Barometric Pressure
Static Pressure, (P_S)
Filter Number(s)

LEAK CHECKS

Pretest: Ambient Temp.
@-20"
400F
@-20"
Post test: 400F
@-20"

Probe Length and Type
Nozzle, I.D.
Assumed Moisture, %
XAD-2 Module Number
Meter Box Number Oven Number
Meter ΔH
C Factor
Probe Heater Setting
Oven Setting
Reference ΔP
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ___ MINUTES

Traverse point number	Sampling time, min	Clock time (24 hr clock) CST	Gas meter reading (V_m), ft³	Velocity head (ΔP_s), in. H_2O	Orifice pressure differential (ΔH), in H_2O Desired	Orifice pressure differential (ΔH), in H_2O Actual	Stack temperature (T_s), °F	Dry gas meter temperature Inlet ($T_{m_{in}}$), °F	Dry gas meter temperature Outlet ($T_{m_{out}}$), °F	Pump vacuum in Hg	Oven temperature °F	Impinger temperature °F	Sorbent trap temperature °F	Probe temperature °F
	stop	0010	Changed filter/Drain condensate reservoir											
			Leak checked before restarting -- 0.002 cfm @-20"											
	start	0057	1594.2	1.50	1.65	1.65	239	49	52	-17.5	399	40	51	387
	305	0112	1647.2	1.50	1.65	1.60	238	58	52	-21.5	400	44	66	385
	315	0122	1680.7	1.50	1.65	1.45	240	62	54	-22	396	46	68	383
End	315	0122	1680.7											
Total	315	[illegible]	1064.0	(√ΔP)avg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average	[illegible]	[illegible]	[illegible]	1.22	[illegible]	1.56	229.7	62.4		[illegible]	401	53	64	387

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TABLE 6-108. SASS SAMPLING DATA SHEETS

Plant Shawnee Steam Plant
Date January 31, 1979
Sampling Location Oxidation Tank Vent
Source I.D. SSP-OTV
Run Number OTV-2
Operator Kohler/Howes
Ambient Temperature 13 F
Barometric Pressure 30.21 in Hg
Static Pressure, (P_S) Atmospheric
Filter Number(s) SSP-14 (1 filter)

LEAK CHECKS

Pretest: Ambient Temp.
0.01 cfm @-20"
400F
0.015 cfm @-20"
Post test: 400F
0.015 cfm @-20"

Probe Length and Type 36"- 316 stainless steel
Nozzle, I.D. 0.50
Assumed Moisture, % 5%
XAD-2 Module Number 4100-018
Meter Box Number BCL33937 Oven Number 3070-022
Meter ΔH. 1.80 in H_2O
C Factor --
Probe Heater Setting 400 F
Oven Setting 400 F
Reference ΔP
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 15 MINUTES

Traverse point number	Sampling time, min	Clock time (24 hr clock) CST	Gas meter reading (V_m), ft³	Velocity head (Δp_s), in. H_2O	Orifice pressure differential (ΔH), in H_2O		Stack temperature (T_s), °F	Dry gas meter temperature		Pump vacuum in Hg	Oven temperature °F	Impinger temperature °F	Sorbent trap temperature °F	Probe temperature °F
					Desired	Actual		Inlet ($T_{m_{in}}$), °F	Outlet ($T_{m_{out}}$), °F					
	0	1030	196.4	0.02	1.8	1.8	99	38	35	-12.5	394	41	56	318
	15	1045	252.7	0.02	1.8	1.8	100	48	40	-13	392	52	50	310
	30	1100	309.5	0.02	1.8	1.8	100	56	48	-13	394	52	51	303
	45	1115	366.8	0.02	1.8	1.8	99	59	53	-12.5	397	52	52	309
	60	1130	422.5	0.02	1.8	1.8	99	60	55	-13	397	54	50	308
	75	1145	479.8	0.02	1.8	1.8	99	61	57	-13	396	54	53	308
	90	1200	540.8	0.02	1.8	1.8	101	63	59	-13	399	59	53	316
	105	1215	594.5	0.02	1.8	1.8	103	63	61	-13	395	57	53	317
	120	1230	651.8	0.02	1.8	1.8	102	65	61	-13	396	52	52	314
	135	1245	705.3	0.03	1.8	1.8	103	71	66	-13	397	53	52	318
	150	1300	762.4	0.04	1.8	1.8	104	73	68	-13	391	53	52	319
	165	1315	819.7	0.04	1.8	1.8	105	74	69	-13	397	53	52	319
	180	1330	876.9	0.04	1.8	1.8	106	74	70	-13	395	53	52	318
	195	1345	934.2	.04	1.8	1.8	105	74	70	-13	396	53	52	316
	209	1400	968.65	.04	1.8	1.0	104	70	69		405	51	42	383
	stop	1400	968.65	Stopped/Ice plug in silica gel										
				Leak checked before restarting -- 0.005 cfm @ 20"										
	start	1425	974.85											
	210	1426	976.6	Stopped/Ice plug in silica gel										
				Leak checked before restarting -- 0.005 cfm @ 20"										
Total		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Page 1 of 2

TABLE 6-108. (Continued)

Plant Shawnee Steam Plant
Date January 31, 1979
Sampling Location Oxidation Tank Vent
Source I.D. SSP-OTV
Run Number OTV-2 (Continued)
Operator
Ambient Temperature
Barometric Pressure
Static Pressure, (P_S)
Filter Number(s)

LEAK CHECKS
Pretest: Ambient Temp.
______ @-20"
400F
______ @-20"
Post test: 400F
______ @-20"

Probe Length and Type
Nozzle, I.D.
Assumed Moisture, %
XAD-2 Module Number
Meter Box Number ______ Oven Number
Meter ΔH.
C Factor
Probe Heater Setting
Oven Setting
Reference ΔP
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ___ MINUTES

Traverse point number	Sampling time, min	Clock time (24 hr clock) CST	Gas meter reading (V_m), ft³	Velocity head (ΔP_s), in. H_2O	Orifice pressure differential (ΔH), in H_2O		Stack temperature (T_s), °F	Dry gas meter temperature		Pump vacuum in Hg	Oven temperature °F	Impinger temperature °F	Sorbent trap temperature °F	Probe temperature °F
					Desired	Actual		Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F					
	start	1440	977.35	0.04	1.8	1.8	106	67	66	-13	397	57	38	377
	220	1450	1016.8	0.04	1.8	1.8	106	79	70	-13	394	48	50	323
	235	1505	1075.5	0.04	1.8	1.8	105	83	75	-12	386	49	51	322
	250	1520	1133.6	0.04	1.8	1.8	106	85	78	-12	393	51	53	324
	265	1535	1191.8	0.04	1.8	1.8	106	86	79	-12	403	52	54	324
	280	1550	1251.5	0.04	1.8	1.8	105	87	81	-12	395	53	55	322
	295	1605	1308.5	0.04	1.8	1.8	105	87	81	-12	396	53	55	321
	305	1615	1347.4	0.04	1.8	1.8	105	88	82	-12	399	51	55	321
TOTAL	305		1144.05	($\sqrt{\Delta P}$)avg										
AVERAGE				0.176		1.77	103	67.5			396	52	51	322

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TABLE 6-109 . SASS SAMPLING DATA SHEETS

Plant Shawnee Steam Plant
Date February 2, 1979
Sampling Location TCA Outlet/after reheat
Source I.D. TCAS
Run Number TCAS-3
Operator D. Kohler/J. Howes
Ambient Temperature 37 F
Barometric Pressure 30.33 in Hg
Static Pressure, (P_s) -25 in H_2O
Filter Number(s) SSP-15, 17, 19, 20,21,22,23,& 24
Total - 8 filters

LEAK CHECKS

Pretest: Ambient Temp.
0.015 cfm @-20"
400F
0.01 cfm @-20"

Post test: 400F
0.01 cfm @-20"

Probe Length and Type 36" - 316 stainless steel, heated
Nozzle, I.D. 0.50
Assumed Moisture, % 13
XAD-2 Module Number 4100-018
Meter Box Number BCL 33937 Oven Number 3070-022
Meter ΔH. 1.8 in H_2O
C Factor ---
Probe Heater Setting 400 F
Oven Setting 400 F
Reference ΔP 1.6 in H_2O
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 10 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK) CST	GAS METER READING (V_m), ft³	VELOCITY HEAD (ΔP_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM in Hg	OVEN TEMPERATURE °F	IMPINGER TEMPERATURE °F	SORBENT TRAP TEMPERATURE °F	PROBE TEMPERATURE °F
					DESIRED	ACTUAL		INLET $(T_{m_{in}})$, °F	OUTLET $(T_{m_{out}})$, °F					
	0	0915	0352.2	3.2*	1.8	1.8	218	39	39	-15	390	44	37	399
	5	0920	0369.9	3.2*	1.8	1.8	218	46	40	-16	396	50	53	391
	15	0930	0406.1	2.6*	1.8	1.8	240	59	48	-19	398	62	59	392
	31	0946	0464.2	2.5*	1.8	1.65	241	65	56	-22	396	73	63	390
	35	0950	0478.2	2.4*	1.8	1.6	234	66	56	-22	399	74	61	389
	stop	0950	Changed filter/drained condensate/replaced defective magnehelic											
			Leak checked before restarting -- 0.025 cfm @-20"											
	start	1055	0480.3	1.7	1.8	1.8	229	49	49	-15	398	43	46	388
	45	1105	0517.0	1.8	1.8	1.8	225	64	53	-17.5	398	54	62	386
	55	1115	0553.3	1.8	1.8	1.8	233	69	59	-20	400	62	65	397
	65	1125	0589.8	1.9	1.8	1.6	223	71	62	-22	400	68	65	392
	stop	1125	Changed filter/Drain condensate											
			Leak checked before restarting -- 0.007 cfm @ -20"											
	start	1213	0596.2	1.8	1.8	1.8	229	55	56	-15	399	46	44	389
	75	1223	0632.8	1.9	1.8	1.8	237	66	58	-17.5	400	56	59	399
	85	1233	0669.6	1.9	1.8	1.8	234	71	63	-20.5	400	58	62	398
	95	1243	0705.7	1.9	1.8	1.6	234	73	66	-22	401	64	64	395
	stop	1243	Changed filter/Drain condensate											
			Leak checked before restarting -- 0.035 CFM @ -24"											
TOTAL														
AVERAGE														

COMMENTS * Uncertain about ΔP reading - Control room shows ~30,000 cfm (normal) Page 1 of 3

TABLE 6-109. (Continued)

Plant Shawnee Steam Plant
Date February 2, 1979
Sampling Location TCA Outlet/after reheat
Source I.D. TCAS
Run Number TCAS-3 (Continued)
Operator
Ambient Temperature
Barometric Pressure
Static Pressure, (P_S)
Filter Number(s)

LEAK CHECKS
Pretest: Ambient Temp.
__________ @-20"
400F
__________ @-20"
Post test: 400F
__________ @-20"

Probe Length and Type
Nozzle, I.D.
Assumed Moisture, %
XAD-2 Module Number
Meter Box Number __________ Oven Number
Meter ΔH.
C Factor
Probe Heater Setting
Oven Setting
Reference ΔP
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ___ MINUTES

Traverse Point Number	Sampling Time, min	Clock Time (24 hr clock) CST	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H₂O	Orifice Pressure Differential (ΔH), in H₂O		Stack Temperature (T_s), °F	Dry Gas Meter Temperature		Pump Vacuum in Hg	Oven Temperature °F	Impinger Temperature °F	Sorbent Trap Temperature °F	Probe Temperature °F
					Desired	Actual		Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F					
	start	1340	711.3	1.9	1.8	1.8	232	59	59	-15	399	57	42	402
	105	1350	748.3	1.9	1.8	1.8	236	71	62	-17	400	56	60	390
	115	1400	785.3	1.9	1.8	1.8	232	76	67	-20	401	58	64	404
	125	1410	822.3	1.9	1.8	1.65	233	77	70	-22	401	65	66	395
	stop	1410	Changed Filter/Drain condensate											
			Leak check before restarting -- .009 cfm @ -20"											
	start	1500	826.3	2.0	1.8	1.8	195	63	63	-15	394	56	51	404
	135	1510	863.9	2.0	1.8	1.8	231	75	66	-16.5	401	58	59	392
	145	1520	901.2	1.9	1.8	1.8	235	81	71	-18	400	56	62	397
	155	1530	938.6	1.9	1.8	1.8	235	83	74	-20	399	58	64	401
	165	1540	976.2	1.9	1.8	1.7	233	84	77	-22	400	62	66	399
	stop	1540	Changed Filter/Drained condenser											
			Leak Check before restartin -- 0.03 cfm @ -20"											
	start	1630	978.6	1.9	1.8	1.8	234	65	67	-15	396	51	51	379
	175	1640	1015.3	1.9	1.8	1.8	234	68	67	-16.5	397	54	61	387
	185	1650	1052.5	1.9	1.8	1.8	237	76	69	-18	399	53	65	390
	195	1700	1089.8	1.9	1.8	1.8	237	79	72	-21	399	57	66	390
	205	1710	1126.3	1.9	1.8	1.6	234	80	74	-22	399	62	69	386
	stop	1710	Changed filter/Drained condenser											
			Leak check before restarting -- 0.008											
Total		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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TABLE 6-109. (Continued)

Plant Shawnee Steam Plant
Date February 2, 1979
Sampling Location TCA Outlet/after reheat
Source I.D. TCAS
Run Number TCAS 3(Continued)
Operator
Ambient Temperature
Barometric Pressure
Static Pressure, (P_S)
Filter Number(s)

LEAK CHECKS
Pretest: Ambient Temp.
____ @-20"
400F
____ @-20"
Post test: 400F
____ @-20"

Probe Length and Type
Nozzle, I.D.
Assumed Moisture, %
XAD-2 Module Number
Meter Box Number Oven Number
Meter ΔH.
C Factor
Probe Heater Setting
Oven Setting
Reference ΔP
Calculations and Report Checked By

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ___ MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK) CST	GAS METER READING (V_m), ft³	VELOCITY HEAD (ΔP_s), in. H₂O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H₂O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM in Hg	OVEN TEMPERATURE °F	IMPINGER TEMPERATURE °F	SORBENT TRAP TEMPERATURE °F	PROBE TEMPERATURE °F
					DESIRED	ACTUAL		INLET ($T_{m_{in}}$), °F	OUTLET ($T_{m_{out}}$), °F					
	start	1755	1128.2	1.9	1.8	1.8	237	63	66	-16	400	52	52	399
	215	1805	1165.4	1.9	1.8	1.8	215	66	65	-17	398	54	62	391
	225	1815	1202.5	2.0	1.8	1.8	228	72	67	-20	399	54	65	394
	235	1825	1239.8	2.0	1.8	1.75	219	77	69	-22	399	58	66	392
	245	1835	1276.1	2.0	1.8	1.6	217	79	72	-22	399	63	73	386
	stop		Changed filter/Drain condensate											
			Leak checked before restarting -- 0.018 cfm @ -20"											
	start	1925	1279.6	2.0	1.8	1.8	233	61	64	-15	408	49	50	395
	255	1935	1316.4	2.0	1.8	1.8	229	66	64	-17	400	52	63	391
	265	1945	1353.6	2.0	1.8	1.8	224	71	65	-18	400	53	66	392
	275	1955	1390.8	2.0	1.8	1.8	226	74	68	-20	401	58	68	391
	285	2005	1428.9	2.0	1.8	1.8	222	77	70	-21	401	61	67	394
	stop	-- End of Run 2005 Hrs												
			Leak checked at end of test -- 0.02 cfm @ -20"											
TOTAL	285	[illegible]	1050.8	($\sqrt{\Delta P}$)avg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AVERAGE	[illegible]	[illegible]	[illegible]	1.38	[illegible]	1.76	229	65.8		[illegible]	399	57	60	393

[illegible]

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TABLE 6-110. SASS SAMPLE RECOVERY DATA SHEETS

SASS ANALYTICAL DATA

Plant Shawnee Steam Plant Sample No. ________
Sampling Location Venturi Scrubber Outlet Run No. VSS-1
Recovered By Howes & Kohler Recovery Date 1/30/79 Run Date 1/29/79
Comments ________
Analyst J. Howes

FILTERS USED	FILTER HOLDER		CYCLONES Used (yes/no)	CYCLONES Prepared Container (No.)
No. SSP-1 (a)	No. 1			
SSP-7 (b)	2			
SSP-8 (c)	1	10μ	yes	VSS-10C
SSP-9 (d)	2	3μ	yes	VSS-3C
SSP-10 (e)	1	1μ	yes	VSS-1C

IMPINGER VOLUMES

	Initial	Final	Rinse	Totals
First (H_2O_2)	750 mℓ	1154 mℓ	81 mℓ	1235 mℓ
Second (APS + $AgNO_3$)	500 mℓ	595 mℓ	180 mℓ	775 mℓ
Third (APS + $AgNO_3$)	500 mℓ	462 mℓ	110 mℓ	572 mℓ
TOTALS	1750 mℓ	2211 mℓ	Gain	461 mℓ

SILICA GEL WEIGHTS

	Initial	Final
	750 g	g
	250 g	1254.7 g
	g	g
TOTALS	1000 g	1254.7 g

Gain 254.7 g

CONDENSATE

TOTAL VOLUME COLLECTED 2538 mℓ

Volume Neat	2538 mℓ
Volume Extracted	2572 mℓ
Volume CH_2Cl_2 Extract (3 x ____ mℓ)	445 mℓ

Extracted Condensate:	pH Neat	~3
	Amount 96% HNO_3 added	
	pH Final	2 & 12

HCl used to acidify condensate for extraction

Calculations and Report Checked By ________

TOTAL GAIN 3253.7 mℓ

FILTER DATA (Continued)

SSP-11 (f)	2
SSP-12 (g)	1
SSP-13 (h)	2

Condenser Rinse Volume (Methylene Chloride) 220 mℓ

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TABLE 6-111. SASS SAMPLE RECOVERY DATA SHEETS

SASS ANALYTICAL DATA

Plant Shawnee Steam Plant Sample No. ______

Sampling Location Oxidation Tank Vent/Venturi Scrubber Run No. OTV-2

Recovered By Howes & Kohler Recovery Date 2/1/79 Run Date 1/31/79

Comments ______

Analyst J. Howes

FILTERS USED	FILTER HOLDER	CYCLONES	Used (yes/no)	Prepared Container (No.)
No. SSP-14 (a)	No. 1			
		10μ	yes	OTV-10C
		3μ	yes	OTV-3C
		1μ	yes	OTV-1C

IMPINGER VOLUMES

	Initial	Final	Rinse	Totals
First (H_2O_2)	750 mℓ	1400 mℓ	91 mℓ	1491 mℓ
Second (APS + $AgNO_3$)	500 mℓ	510 mℓ	115 mℓ	625 mℓ
Third (APS + $AgNO_3$)	500 mℓ	500 mℓ	140 mℓ	640 mℓ
TOTALS	1750 mℓ	2410 mℓ	Gain	660 mℓ

SILICA GEL WEIGHTS

	Initial	Final
	1250 g	1448.2 g
	g	g
	g	g
TOTALS	1250 g	1448.2 g

Gain 198.2 g

CONDENSATE

TOTAL VOLUME COLLECTED		975 mℓ
Volume Neat	975 mℓ	
Volume Extracted	986 mℓ	
Volume CH_2Cl_2 Extract (3 x 55 mℓ)	160 mℓ	

Extracted Condensate: pH Neat	~7	HCl used to acidify condensate
Amount 96% HNO_3 added		
pH Final	2 & 12	

Calculations and Report Checked By ______ TOTAL GAIN 1833.2 mℓ

FILTER DATA (Continued)

Condenser Rinse Volume 320 mℓ
(Methylene Chloride)

TABLE 6-112. SASS SAMPLE RECOVERY DATA SHEETS

A-11

SASS ANALYTICAL DATA

Plant Shawnee Steam Plant   Sample No. ______

Sampling Location TCA Scrubber Outlet   Run No. TCAS-3

Recovered By Howes & Kohler   Recovery Date 2/3/79   Run Date 2/2/79

Comments ______

Analyst J. Howes

FILTERS USED	FILTER HOLDER	CYCLONES	Used (yes/no)	Prepared Container (No.)
No. SSP-15 (a)	No. 2			
SSP-17 (b)	1			
SSP-19 (c)	2	10µ	yes	TCAS-10C
SSP-20 (d)	1	3µ	yes	TCAS-3C
SSP-21 (e)	2	1µ	yes	TCAS-1C

IMPINGER VOLUMES

	Initial	Final	Rinse	Totals
First (H_2O_2)	750 mℓ	1060 mℓ	212 mℓ	1272 mℓ
Second (APS + $AgNO_3$)	500 mℓ	560 mℓ	150 mℓ	938 mℓ
Third (APS + $AgNO_3$)	500 mℓ	448 mℓ	113 mℓ	333 mℓ
TOTALS	1750 mℓ	2068 mℓ	Gain	318 mℓ

SILICA GEL WEIGHTS

	Initial	Final		
	1250 g	1497.5 g		
	g	g		
	g	g		
TOTALS	1250 g	1497.5 g	Gain	247.5 g

CONDENSATE

TOTAL VOLUME COLLECTED   2135 mℓ

Volume Neat   2135 mℓ

Volume Extracted   2161 mℓ

Volume CH_2Cl_2 Extract (3 x 45 mℓ)   460 mℓ   HCl used to acidify condensate

Extracted Condensate: pH Neat   ~3

Amount 96% HNO_3 added ______

pH Final   2 & 12

Calculations and Report Checked By ______   TOTAL GAIN 2700.5 mℓ

FILTER DATA (Continued)

SSP-22 (f)	1
SSP-23 (g)	2
SSP-24 (h)	1

Condenser Rinse Volume (Methylene Chloride)   300 mℓ

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TABLE 6-113. SASS SAMPLE WEIGHT DATA

Date Weighed T January 27, 1979

Date Weighed G February 6, 1979

Balance Used Mettler HGT #184191

PARTICULATE LOADING DATA

FIELD → → → LAB → → → FIELD

Weighings Performed By J. Howes

Calculations Checked By

Give Gross (G), Tare (T), and Net (N) Weights and Units for All Applicable Samples

Sample No. and Site Name and Location	Particulate Filter SSP-BCL-PFa-VSS-1	1μ Cyclone SSP-BCL-1C-VSS-1	3μ Cyclone SSP-BCL-3C-VSS-1	10μ Cyclone SSP-BCL-10C-VSS-1	Probe Rinse Solids Volume-450 ml
Run VSS-1 Venturi Scrubber Shawnee Steam Plant, Paducah Ky	G 1.1855 g T 1.0253 g N 0.1602 g	G81.9406 g T81.8929 g N 0.0477 g	G 80.9330 g T 80.9004 g N 0.0326 g	G 81.7717 g T 81.3131 g N 0.4586 g	SSP-BCL-PR-VSS-1 G 147.6368 g T 147.2787 g N 0.3581 g
	SSP-BCL-PFb-VSS-1 G 1.2594 g T 1.1266 g N 0.1328 g	G T N	G T N	G T N	G T N
	SSP-BCL-PFc-VSS-1 G 1.2494 g T 1.1267 g N 0.1227 g	G T N	G T N	G T N	G T N
	SSP-BCL-PFd-VSS-1 G 1.2645 g T 1.1345 g N 0.1300 g	G T N	G T N	G T N	G T N
	SSP-BCL-PFe-VSS-1 G 1.2869 g T 1.1524 g N 0.1345 g	G T N	G T N	G T N	G T N

TABLE 6-113. (Continued)

Date Weighed T January 27, 1979
Date Weighed G February 6, 1979
Balance Used Mettler HGT #184191

PARTICULATE LOADING DATA

FIELD → → → LAB → → → FIELD

Weighings Performed By J. Howes
Calculations Checked By

Give Gross (G), Tare (T), and Net (N) Weights and Units for All Applicable Samples

Sample No. and Site Name and Location	Particulate Filter	1μ Cyclone	3μ Cyclone	10μ Cyclone	Probe Rinse Solids
Run VSS-1 (Continued)	SSP-BCL-PFF-VSS-1				
	G 1.2579 g	G	G	G	G
	T 1.1378 g	T	T	T	T
	N 0.1201 g	N	N	N	N
	SSP-BCL-PFg-VSS-1				
	G 1.2616 g	G	G	G	G
	T 1.1304 g	T	T	T	T
	N 0.1312 g	N	N	N	N
	G	G	G	G	G
	T	T	T	T	T
	N	N	N	N	N
Total Catch	G	G	G	G	G
	T	T	T	T	T
	N 1.0463 g	N 0.0477 g	N 0.0326 g	N 0.4586 g	N 0.3581 g
	G	G	G	G	G
	T	T	T	T	T
	N	N	N	N	N

TABLE 6-114. SASS SAMPLE WEIGHT DATA

Date Weighed T January 27, 1979
Date Weighed G February 6, 1979
Balance Used Mettler H6T #184191

PARTICULATE LOADING DATA

FIELD → → → [✓ LAB] → → → FIELD

Weighings Performed By J. Howes
Calculations Checked By

Give Gross (G), Tare (T), and Net (N) Weights and Units for All Applicable Samples

Sample No. and Site Name and Location	Particulate Filter	1μ Cyclone	3μ Cyclone	10μ Cyclone	Probe Rinse Solids Volume - 250 ml
RUN OTV-2 Oxidation tank vent pipe/ Venturi Scrubber Shawnee Steam Plant Paducah, Ky	SSP-BCL-PFa-OTV-2 G 1.1228g T 1.1217g N 0.0011g	G No particulates collected in 1μ cyclone T N	G No particulates collected in 3μ cyclone T N	G No particulates collected in 10 μ cyclone T N	G 141.0803g T 141.0618g N 0.0185g
	G T N	G T N	G T N	G T N	G T N
	G T N	G T N	G T N	G T N	G T N
Total catch	G T N 0.0011g	G T N	G T N	G T N	G T N 0.0185g
	G T N	G T N	G T N	G T N	G T N

TABLE 6-115. SASS SAMPLE WEIGHT DATA

PARTICULATE LOADING DATA

Date Weighed T January 27, 1979

Date Weighed G February 6, 1979

Balance Used Mettler H6T, #184191

FIELD → → → [✓ LAB] → → → FIELD

Weighings Performed By J. Howes

Calculations Checked By

Give Gross (G), Tare (T), and Net (N) Weights and Units for All Applicable Samples

Sample No. and Site Name and Location	Particulate Filter	1µ Cyclone	3µ Cyclone	10µ Cyclone	Probe Rinse Solids Volume - 425 ml
RUN TCAS-3 TCA scrubber Shawnee Steam Plant Paducah, Ky.	SSP-BCL-PFa_TCAS-3 G 1.2525g T 1.1325g N 0.1200g	SSP-BCL-1C-TCAS-3 G 82.3794g T 81.6589g N 0.7205g	SSP-BCL-3C-TCAS-3 G 82.0420g T 81.8076g N 0.2344g	SSP-BCL-10C-TCAS-3 G 82.3087g T 82.1275g N 0.1812g	G 149.1372g T 148.7772g N 0.3600g
	SSP-BCL-PFb-TCAS-3 G 1.2512g T 1.1452g N 0.1060g	G T N	G T N	G T N	G T N A-15
	SSP-BCL-PFc-TCAS-3 G 1.2481g T 1.1315g N 0.1066g	G T N	G T N	G T N	G T N
	SSP-BCL-pfd-TCAS-3 G 1.2401g T 1.1300g N 0.1101g	G T N	G T N	G T N	G T N
	SSP-BCL-PFe-TCAS-3 G 1.2209g T 1.1181g N 0.1028g	G T N	G T N	G T N	G T N

TABLE 6-115. (Continued)

PARTICULATE LOADING DATA

FIELD → → → [✓ LAB] → → → FIELD

Date Weighed T January 27, 1979
Date Weighed G February 6, 1979
Balance Used Mettler H6T, #184191

Weighings Performed By J. Howes
Calculations Checked By

Give Gross (G), Tare (T), and Net (N) Weights and Units for All Applicable Samples

Sample No. and Site Name and Location	Particulate Filter	1μ Cyclone	3μ Cyclone	10μ Cyclone	Probe Rinse Solids
RUN TCAS-3 (Continued)	SSP-BCL-PFf-TCAS-3 G 1.2451g T 1.1261g N 0.1190g	G T N	G T N	G T N	G T N
	SSP-BCL-PF g-TCAS-3 G 1.2568g T 1.1368g N 0.1200g	G T N	G T N	G T N	G T N
	SSP-BCL-PFh-TCAS-3 G 1.2200g T 1.1384g N 0.0816g	G T N	G T N	G T N	G T N
Total catch	G T N 0.8661g	G T N 0.7205g	G T N 0.2344g	G T N 0.1812g	G T N 0.3600g
MMB-Methanol/ methylene chloride blank for RUNS, VSS-1, OTV-2, & TCAS-3	G T N	G T N	G T N	G T N	G 146.5413g T 146.5423g N 0.0010g

TABLE 6-116. PROCESS SAMPLING DATA SHEETS

SOLIDS FIELD DATA
GENERAL

Sample Site Shawnee Steam Plant/Scrubber Facility

Type of Source Venturi scrubber system

Sampling Location Sampling point 1821

Sample Type: Inorganic x Organic ______

Sample Number SSP-BCL-FC-1/29/79-VS1821 **Date Taken** 1/29/79 1638 hrs CST

Staff Signature James E. Howes, Jr./Jerry Clapp (TVA)

Sampling Device scoopula **Sample Mass or Volume** 2 kg

Composite Sample: Yes ______ or No x .

If Composite, Number and/or Volume of Portions of Composite: ______ / ______

Sample Description: Homogeneous ______ Heterogeneous x Powder ______ Small ______ Pieces ______

Large Pieces ______ Color gray Wet x Dry ______

Sampling Problems None

Solids - 87.3%
Water - 12.6%

TABLE 6-117. PROCESS SAMPLING DATA SHEETS

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LIQUIDS FIELD DATA
GENERAL

Sample Site Shawnee Steam Plant/Scrubber Facility

Type of Source Venturi scrubber system

Sampling Location Sampling point VS1816

Sample Type: Aqueous x Slurry x Organic ____

Sample Number SSP-BCL-VSTS-1/29/79-VS1816 Data Taken 1/29/79 1649 hrs CST

Staff Signature James E. Howes Jr./Jerry Clapp (TVA)

Sampling Device Tap Sample Mass or Volume 12 liters

Composite Sample: Yes ____ or No x

If Composite, Number and/or Volume of Portions of Composite: ____ / ____

Sample Description: Fluid x Viscous ____ Hot x Cold ____ Flowing x Still ____

Homogeneous ____ Heterogeneous x Color ____

Sampling Problems None

TVA Lab analysis obtained

TABLE 6-118. PROCESS SAMPLING DATA SHEETS

SOLIDS FIELD DATA
GENERAL

Sample Site Shawnee Steam Plant/Scrubber Facility

Type of Source TCA scrubber system

Sampling Location Centrifuge cake discharge

Sample Type: Inorganic X Organic

Sample Number SSP-BCL-CC-2/2/79-TCA Date Taken 2/7/79 0845 CST

Staff Signature James E. Howes, Jr./Jerry Clapp (TVA)

- -

Sampling Device Scoopula Sample Mass or Volume ~2 kg

Composite Sample: Yes ____ or No x .

If Composite, Number and/or Volume of Portions of Composite: ____ / ____

Sample Description: Homogeneous ____ Heterogeneous x Powder ____ Small ____ Pieces ____

Large Pieces x Color gray Wet x Dry ____

Sampling Problems None

Solids - 63%
Water - 37%

ADDITIONAL DATA

TABLE 3. SASS MASS LOADING AND PARTICULE SIZE DISTRIBUTION DATA

SASS Sample	Venturi Scrubber Flue Gas			Oxidation Tank Vent Fugitive Emissions			TCA Scrubber Flue Gas		
	Mass Collected, g	% Distribution by Weight	Mass(a) Loading, mg/m^3	Mass Collected, g	% Distribution by Weight	Mass(b) Loading, mg/m^3	Mass Collected, g	% Distribution by Weight	Mass(c) Loading, mg/m^3
10μ cyclone catch	0.4586	23.6	14.8	0.0000	0.0	0.00	0.1812	7.7	6.0
3μ cyclone catch	0.0326	1.7	1.1	0.0000	0.0	0.00	0.2344	9.9	7.7
1μ cyclone catch	0.0477	2.5	1.5	0.0000	0.0	0.00	0.7205	30.5	23.7
Filter catch	1.0463	53.8	33.9	0.0011	5.6	0.03	0.8661	36.7	28.5
Probe & cyclone rinse	0.3581	18.4	11.6	0.0185	94.4	0.56	0.3600	15.2	11.8
Totals	1.9433	100	62.9	0.0196	100	0.60	2.3622	100	77.7

(a) Sample volume - 30.906 m^3 (std-dry)

(b) " " - 32.874 m^3 (" ")

(c) " " - 30.410 m^3 (" ")

TABLE 5. LEVEL 1 CHEMICAL ANALYSES PERFORMED ON SHAWNEE SCRUBBER SAMPLES

Sample	Inorganic Analysis		Organic Analysis							
			Neat Extracts				LC Fractions			
	SSMS	AAS$^{(a)}$	TCO	GRAV	IR	LC	TCO	GRAV	IR	LRMS$^{(b)}$
SASS Samples - Venturi Scrubber Stack Gas										
Probe & cyclone rinse	X	Hg		X	X					
10 + 3μm particulates	X	Hg		X	X	Ø✓				
1μm + filter particulates	X	Hg		X	X	X	X	X	X	6/7
XAD-2 + Module rinse	X	Hg	X	X	X	X	X	X	X	6/7
Extract of condensate			X	X	X	Ø				
Aq. condensate + 1st impinger	X	Hg								
2nd + 3rd impinger		Hg, As, Sb								
SASS Samples - Oxidation Tank Vent Emissions										
Probe & cyclone rinse	X			Ø	Ø					
Filter	X	Hg		X	X	Ø				
XAD-2 + Module rinse	X	Hg	X	X	X	X	X	X	X	6/7
Extract of condensate			X	X	X	Ø				
Aq. condensate + 1st impinger	X	Hg								
2nd + 3rd impinger		Hg, As, Sb								
SASS Samples - TCA Stack Gas										
Probe & cyclone rinse	X	Hg		X	X					
10 + 3 μm particulates	X	Hg		X	X	Ø✓				
1μm + filter particulates	X	Hg		X	X	X	X	X	X	6/7
XAD-2 + module rinse	X	Hg	X	X	X	X	X	X	X	
Extract of condensate			X	X	X	Ø				
Aq. condensate + 1st impinger	X	Hg								
2nd + 3rd impinger		Hg, As, Sb								

TABLE 5. (Continued)

Sample	Inorganic Analysis		Organic Analysis							
			Neat Extracts			LC	LC Fractions			
	SSMS	AAS[a]	TCO	GRAV	IR		TCO	GRAV	IR	LRMS[b]
Scrubber Samples										
Venturi spray tower slurry	X	Hg	X	X	X	X	X	X	X	
Venturi filter cake	X	Hg	X	X	X	X	X	X	X	
TCA centrifuge cake	X	Hg	X	X	X					

(a) Element(s) analyzed by AAS are indicated.

(b) Indicates LC fraction analyzed by LRMS.

TABLE 6. SUMMARY OF ORGANIC MASS CONCENTRACTION IN SASS AND SCRUBBER PROCESS SAMPLES

Sample	Venturi Scrubber TCO + GRAV, mg/m^3	Oxidation Tank Vent TCO + GRAV, mg/m^3	TCA Scrubber TCO + GRAV, mg/m^3
SASS probe & cyclone rinse	0.10	NS(a)	0.13
SASS 10 + 3μm particulates	2.13	NS	1.01
SASS 1μm + filter particulates	3.00	0.49	1.28
SASS XAD-2 + module rinse	1.37	1.49	1.15
SASS condensate extract	0.09	0.03	0.10
Totals	6.69	2.01	3.67
Venturi spray tower slurry, TCO + GRAV	3.97 mg/liter		
Venturi filter cake, TCO + GRAV	15.82 mg Kg		
TCA centrifuge cake, TCO + GRAV	9.67 mg/Kg		

(a) NS - No sample

STUDY NUMBER 7

DATA SOURCE:	**ANALYSES OF GRAB SAMPLES FROM FIXED-BED COAL GASIFICATION PROCESSES**
DATA STATUS:	EPA—600/7-77-141, December 1977
AUTHOR: CONTRACTOR:	Karl J. Bombaugh Radian Corporation P.O. Box 9948 Austin, Texas 78766 Contract No. 68-02-2147
PROJECT OFFICER:	William J. Rhodes Industrial Environmental Research Laboratory Office of Energy, Minerals, and Industry U.S. Environmental Protection Agency Research Triangle Park, NC 27711

Coal gasification is the process of using heating operations to convert coal to a combustible gas. The stated purpose of this study was "to aid in planning for future more comprehensive environmental test programs which will be conducted at [other] gasification facilities." Level 1 samples were taken at five commercial-scale fixed-bed gasifiers and at one pilot-scale operation, identified herein as sites A, B1, B2, B3, C1, and C2. Table 7-1 (from the report) identifies the coal type and samples collected at each site. Emphasis was placed on characterizing site A, which had already been selected for detailed testing at a later date. Some site A preliminary results were reported in an earlier data compilation (ref. 4).

Figure 7-1 (from the document) is a schematic of Site A, which is described as an atmospheric, single-stage, fixed-bed, air-blown gasifier. At site A coal enters the top of the gasification chamber through a barrel valve and is spread across a fixed grating. Steam and air enter through the bottom of the gasification chamber and pass through the grating and the gasification zone. Ash is pushed with a plow from a water-sealed pan at the bottom of the gasifier. The hot product gas goes through a cyclone then through a series of spray-scrubbers into a gas main where product gases from several gasifiers are combined and fed to a combustion chamber. The quench liquor flows to a separator tank where tars and oils are removed to a combustion chamber. Excess (aqueous) separator liquor is pumped to an evaporator, and the remainder is recirculated to the scrubbers.

Sites B-1, B-2, and B-3 are similar to site A except that they burn anthracite coal, which has essentially no tars. These sites also differ in that they burn the product gas directly after removal of large particulates by a hot cyclone. Site C-1, burning bituminous coal, is a commercial-scale unit and cyclone coupled to a flare by a long run of insulated duct.

Site C-2 is a pilot-scale operation burning bituminous coal and consisting of a small gasifier chamber, cyclone, single-stage scrubber, and electrostatic precipitator. The product gas from site C-2 is fed to a test burner.

TABLE 7-1. SAMPLES COLLECTED FOR PRELIMINARY SCREENING

Site	Feed coal type	Cyclone bottom dust	Tar	Gasifier bottom ash	Process condensate	Gas duct dust
A	Bituminous	X	X	X	X	-
B1	Anthracite	X	-	-	-	-
B2	Anthracite	-	-	-	-	X
B3	Anthracite	X	-	-	-	-
C1	Bituminous	X	-	-	-	X
C2	Bituminous	-	X	-	X	-

*All sites utilize single-stage, fixed-bed, air-blown, atmospheric pressure gasifiers.

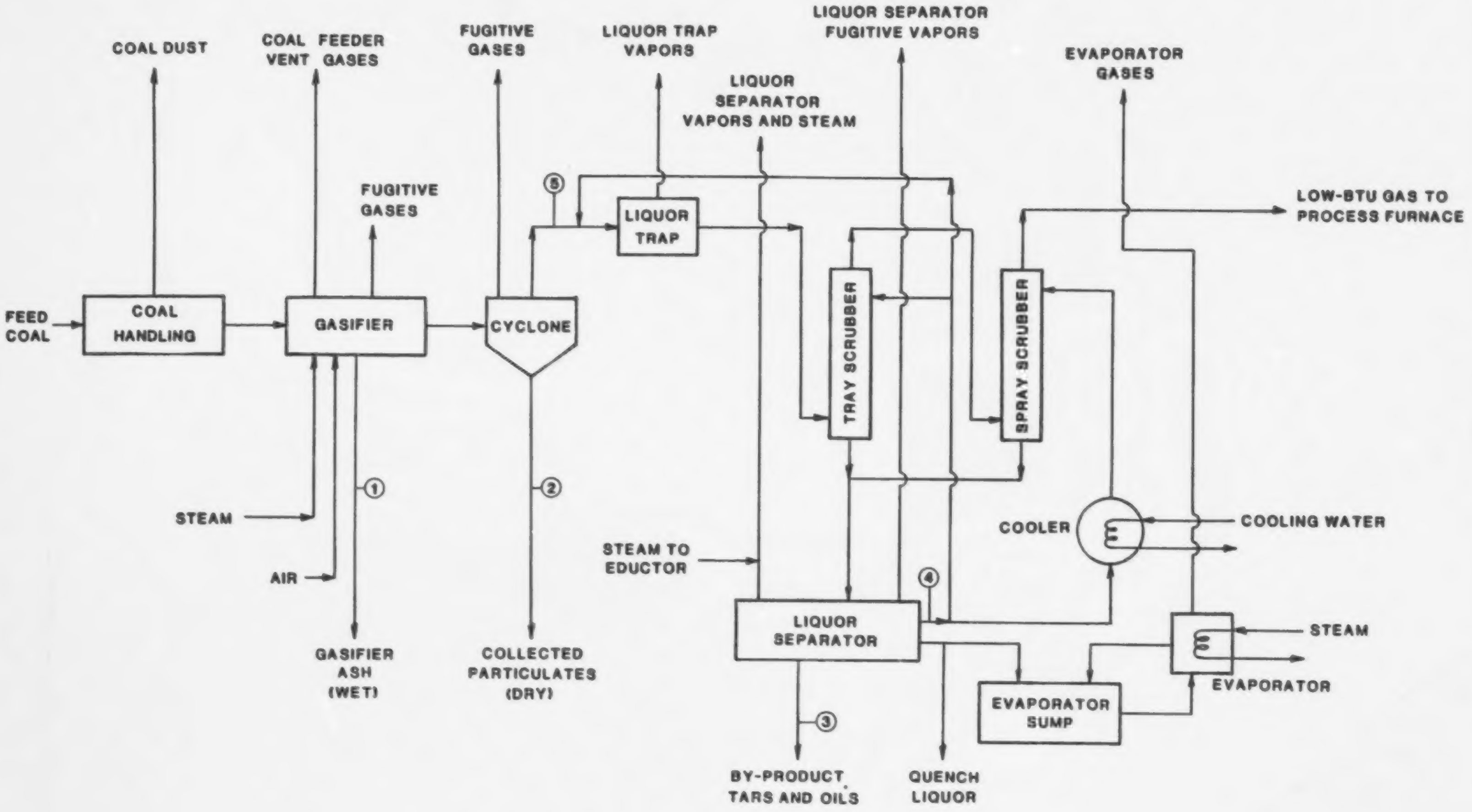

COAL DUST
COAL VENT
FEEDER GASES
FUGITIVE GASES
LIQUOR TRAP VAPORS
LIQUOR SEPARATOR VAPORS AND STEAM
LIQUOR SEPARATOR FUGITIVE VAPORS
EVAPORATOR GASES
FUGITIVE GASES
LOW-BTU GAS TO PROCESS FURNACE
FEED COAL
COAL HANDLING
GASIFIER
CYCLONE
LIQUOR TRAP
TRAY SCRUBBER
SPRAY SCRUBBER
⑤
①
②
STEAM
AIR
COOLER
COOLING WATER
STEAM TO EDUCTOR
④
LIQUOR SEPARATOR
STEAM
EVAPORATOR
GASIFIER ASH (WET)
COLLECTED PARTICULATES (DRY)
EVAPORATOR SUMP
③
BY-PRODUCT TARS AND OILS
QUENCH LIQUOR

Figure 7-1. Gasification unit process flow diagram—site A.

A modified Level 1 protocol was followed for sampling and analysis. Some deviations from the specified Level 1 protocol follow:

1. Organic samples were evaporated directly onto the LC column material.
2. In the determination of C_7-C_{12} hydrocarbons, a 3% OV-101 column was used. The column was programmed at 50° C for 4 minutes then heated at 8° C/minute to 150° C.
3. All elements except Hg were analyzed by SSMS.
4. The Level 1 protocol specifies three 500-mL extractions of 10-L samples. In this study, four 100-mL volumes of CH_2Cl_2 were used to extract a 100-mL sample of separator liquor. One milliliter of the combined extracts was used for GC analysis and the remainder was concentrated by evaporation and weighed.
5. In addition to the modified Level 1 CH_2Cl_2 extraction, subsequent extractions were performed using diethyl ether at pH 1 and pH 7.
6. The tar sample was extracted 24 hours with CH_2Cl_2 in a Soxhlet apparatus. The residue in the Soxhlet thimble was then extracted with tetrahydrofuran (THF) to check for the presence of materials soluble in THF but not soluble in CH_2Cl_2.
7. A tar sample, mixed with a larger volume of CH_2Cl_2, was filtered through a medium-frit filter, then through Whatman No. 42 paper. The filter catches were examined microscopically and weighed.
8. A lower limit of 8 mg of organics (per 50.3 g ash sample) for LC fractionation was used.

Some major results of the study were:

1. The quench liquor contains elemental concentrations that equal or exceed the standards for surface, irrigation, and drinking water in nearly all cases. Selenium levels were outstandingly higher than standards.
2. Site A separator liquor had 3.8 times the level of organics that site C quench liquor contained, and the compositions of these extracts were unexpectedly different.

Some additional procedures were recommended as candidates for inclusion in the Level 1 protocol. A 1:1 ratio of solvent to extracted liquid, with four sequential extractions using CH_2Cl_2 was suggested. Additional extractions at pH 1 and pH 7 using diethyl ether were recommended. UV spectrometry was proposed as a supplement to IR in screening for polycyclic aromatic organics, and HPLC or TLC was suggested to "discriminate between the nonvolatile component classes" in the major (heavier) LC fractions. Elemental analysis of LC fractions for S and N to screen for organosulfur and/or organic nitrogen compounds was recommended. In addition to these recommendations on methodology, further studies on particle removal over a wide range of conditions were recommended.

LEVEL 1

TABLE 7-2. SPARK SOURCE MASS SPECTROSCOPY
SITE A QUENCH LIQUOR
(μg/L)

U		Dy		Rh		Cr	0.03
Th		Tb		Ru		V	0.004
Bi		Gd		Mo	0.06	Ti	0.05
Pb	0.04	Eu		Nb		Sc	≤0.006
Tl		Sm		Zr	0.01	Ca	MC
Hg*	0.007	Nd	≤0.01	Y	≤0.004	K	MC
Au		Pr	0.005	Sr	0.2	Cl	0.3
Pt		Ce	0.01	Rb	0.03	S	MC
Ir		La	≤0.01	Br	0.2	P	MC
Os		Ba	0.1	Se	4	Si	7
Re		Cs	1	As	0.2	Al	1
W		I	0.5	Ge	≤0.02	Mg	2
Ta		Te		Ga	0.006	Na	MC
Hf		Sb	0.1	Zn	0.07	F	≅2
Lu		Sn	0.02	Cu	0.1	B	2
Yb		In	Std	Ni	0.1	Be	
Tm		Cd	≤0.02	Co	≤0.008	Li	0.2
Er		Ag		Fe	3		
Ho		Pd		Mn	0.03		

MC = Major component.

*Flameless atomic absorption.

NOTE: Any element not listed = concentration ≤ 0.004. Carbon, hydrogen, nitrogen, and oxygen are excluded from these analyses.

TABLE 7-3. SPARK SOURCE MASS SPECTROSCOPY
SITE A TAR
(ppm wt.)

U		Dy		Rh		Cr	3
Th		Tb		Ru		V	0.8
Bi		Gd		Mo	1	Ti	29
Pb	10	Eu		Nb		Sc	0.7
Tl		Sm		Zr	0.7	Ca	630
Hg*	0.12	Nd	0.6	Y	≤0.2	K	100
Au		Pr	0.3	Sr	10	Cl	6
Pt		Ce	0.5	Rb	0.2	S	520
Ir		La	0.6	Br	2	P	17
Os		Ba	27.0	Se	3	Si	170
Re		Cs	0.1	As	4	Al	25
W		I	1	Ge	1	Mg	23
Ta		Te		Ga	8	Na	71
Hf		Sb	0.8	Zn	7	F	≅22
Lu		Sn	0.9	Cu	3	B	19
Yb		In		Ni	5	Be	0.1
Tm		Cd		Co†	5	Li	4
Er		Ag		Fe	120		
Ho		Pd		Mn	0.9		

*Flameless atomic absorption.
†Heterogeneous.

NOTE: Any element not listed in the table, if present, was at a concentration less than 0.2 ppm by weight.

TABLE 7-4. SPARK SOURCE MASS SPECTROSCOPY
SITE A CYCLONE DUST
(ppm wt.)

U		Dy		Rh		Cr	90
Th		Tb	9	Ru		V	100
Bi	2	Gd	2	Mo	14	Ti	MC
Pb	60	Eu	1	Nb	12	Sc	12
Tl		Sm	9	Zr	80	Ca	MC
Hg*	0.01	Nd	21	Y	70	K	MC
Au		Pr	5	Sr	340	Cl	720
Pt		Ce	45	Rb	33	S	MC
Ir		La	45	Br	20	P	MC
Os		Ba	460	Se	24	Si	MC
Re		Cs	1	As	27	Al	MC
W		I	4	Ge	5	Mg	MC
Ta		Te		Ga	130	Na	MC
Hf		Sb	8	Zn	85	F	≅720
Lu		Sn	2	Cu	130	B	70
Yb		In	Std	Ni	30	Be	6
Tm		Cd	<2	Co	16	Li	27
Er		Ag	3	Fe	MC		
Ho		Pd		Mn	120		

MC = major component.

*Flameless atomic absorption.

NOTE: Any element not listed = concentration ≤0.2 ppm by weight.

TABLE 7-5. SPARK SOURCE MASS SPECTROSCOPY
GASIFIER ASH
(ppm wt.)

U	56	Dy	17	Rh		Cr	510
Th	86	Tb	4	Ru		V	MC
Bi	0.4	Gd	10	Mo	22	Ti	MC
Pb	7	Eu	5	Nb	82	Sc	29
Tl	0.5	Sm	28	Zr	430	Ca	MC
Hg		Nd	56	Y	260	K	MC
Au		Pr	42	Sr	MC	Cl	230
Pt		Ce	260	Rb	120	S	250
Ir		La	280	Br	12	P	MC
Os		Ba	MC	Se	20	Si	MC
Re	0.3	Cs	10	As	4	Al	MC
W	10	I	0.3	Ge	4	Mg	MC
Ta	2	Te		Ga	66	Na	MC
Hf	10	Sb	1	Zn	26	F	≅56
Lu	2	Sn	4	Cu	540	B	130
Yb	12	In	Std	Ni	120	Be	22
Tm	1	Cd	3	Co	61	Li	190
Er	8	Ag	≤0.3	Fe	MC		
Ho	11	Pd		Mn	680		

MC = major component.

NOTE: Any element not listed = concentration ≤0.2 ppm by weight.

TABLE 7-6. GAS CHROMATOGRAPHY ANALYSIS SITE A QUENCH LIQUOR EXTRACT

Gas	Range	Volatile weight, ppm
GC7	90-110	260*
GC8	110-140	0
GC9	140-160	0
GC10	160-180	2,544
GC11	180-200	2,766
GC12	200-220	917
GC13	>220	800
GC14	>220	800
GC15	>220	800
GC16	>220	800
GC17	>220	800

*GC7 is not usually included in TCO range, i.e., C_8-C_{16}.

TABLE 7-7. GAS CHROMATOGRAPHY ANALYSIS SITE A TAR

Gas	Range	Volatile weight, ppm	No. of peaks
GC7*	90-110	3,000	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	18,200	
GC11	180-200	56,700	
GC12	200-220	72,500	
GC13 GC14 GC15 GC16 GC17	>220	307,500	

*Not usually included in TCO range, i.e., C_8-C_{16}.

Note: Analyses were performed on a 1-mL aliquot of a sample containing about 2.41 mg of tar extract/mL of methylene chloride.

TABLE 7-8. GAS CHROMATOGRAPHY ANALYSIS SITE A QUENCH LIQUOR EXTRACT

Gas	Range	Volatile weight, ppm	No. of peaks
GC7*	90-110	260	
GC8	110-140	0	
GC9	140-160	0	
GC10	160-180	2,544	
GC11	180-200	2,766	
GC12	200-220	917	
GC13 GC14 GC15 GC16 GC17	>220	800	

*Not usually included in TCO range, i.e., C_8-C_{16}.

Note: The authors note that "The material in the C_7 range is believed to originate with the extracting solvent since it is inconceivable that significant levels of C_7's could be present with no detectable quantities of either C_8's or C_9's."

TABLE 7-9
LC ANALYSIS RESULTS

SAMPLE: ______________________________

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				2231
Recovered[d]				2097 (94.0%)

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
1				0.3
2				1.8
3				5.0
4				17.0
5				163.0
6				1655.0
7				69.0

Sum 2097.1*

*Includes LC fraction 8, at a concentration of 186.0 mg/L. Revised Level 1 procedure (October 1978) utilizes 7 LC fractions.

[a] Quantity in entire sample, determined before LC.

[b] Portion of whole sample used for LC, actual mg.

[c] Quantity recovered from LC column, actual mg.

[d] Total mg computed back to total sample.

[e] Values supplied for both sample size and concentration.

[f] Not detectable.

TABLE 7-10
LC ANALYSIS RESULTS

SAMPLE: ____________________

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				668,864
Taken for LC[c]				560,159 (83.7%)*
Recovered[d]				

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
1				1494
2				10,954
3				96,795
4				47,004
5				41,029
6				293,374
7				27,883
Sum				560,159

*Includes LC fraction 8, at a concentration of 41,626 mg/kg. Revised Level 1 procedure (October 1978) utilizes 7 LC fractions.

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 7-11
LC ANALYSIS RESULTS

SAMPLE: ____________________

	TCO mg	GRAV mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
Total Sample[b]				
Taken for LC[c]				381
Recovered[d]				310 (81.4%)

Fraction	TCO[e] mg	GRAV[e] mg	TCO + GRAV total mg	Concentration[a] mg/ (m^3, L, or kg)
1				109
2				18
3				1
4				3
5				3
6				113
7				19

Sum 310*

*Includes LC fraction 8, 44 mg/kg. The Level 1 procedure now has 7 LC fractions.

---

[a] Quantity in entire sample, determined before LC.
[b] Portion of whole sample used for LC, actual mg.
[c] Quantity recovered from LC column, actual mg.
[d] Total mg computed back to total sample.
[e] Values supplied for both sample size and concentration.
[f] Not detectable.

TABLE 7-12

ORGANIC EXTRACT SUMMARY TABLE

Sample Site A quench liquor extract

	LC1	LC2	LC3	LC4	LC5	LC6	LC7	Σ_*
Total Organics, mg	0.03	0.18	0.50	1.70	16.30	165.50	6.90	209.71
TCO, mg								
GRAV, mg								

TABLE 7-13

ORGANIC EXTRACT SUMMARY TABLE

Sample Site A tar extract

	LC1	LC2	LC3	LC4	LC5	LC6	LC7	Σ_*
Total Organics, mg	0.75	5.5	48.6	23.6	20.6	147.3	14.0	281.25
TCO, mg								
GRAV, mg								

TABLE 7-14

ORGANIC EXTRACT SUMMARY TABLE

Sample Site A cyclone dust extract

	LC1	LC2	LC3	LC4	LC5	LC6	LC7	Σ_*
Total Organics, mg	21.84	3.53	0.21	0.57	0.62	22.69	3.76	62.09
TCO, mg								
GRAV, mg								

TABLE 7-15
IR REPORT

SAMPLE: Site A quench liquor extract

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC Fraction Number
*	*	1 Aliphatic hydrocarbons
*	*	2 Alkyl-aryl hydrocarbons
*	*	3 Alkyl-aryl hydrocarbons, trace carbonyl,
		possible polycyclics or multi-substituted
		aromatics
*	*	4 Alkyl-aryl hydrocarbons, possible polycyclics,
		-OH present (possibly atmosphere moisture)
*	*	5 Phenol + alkyl/dialkyl phenols
*	*	6 Principally Phenol + other phenols
*	*	7 Phenols
*	*	8 Alkyl-aryl CH-stretch, OH, $-\overset{|}{\underset{|}{C}}=O$, Methyl Bending
		Vibration, Primary OH, possible inorganic
		sulfur + other ionic compounds

* Spectra are provided in the "additional data" section; wave numbers and intensity were not reported.

OTHER REMARKS:

TABLE 7-16

IR REPORT

SAMPLE: Site A cyclone dust extract

Wave Number (cm^{-1})	Intensity	Assignment/Comments
		LC Fraction Number
*	*	1 Paraffinic hydrocarbons, considerable branching
*	*	2 Paraffinic functional groups, traces of substituted aromatics
*	*	3,4 Split carbonyls, esters (formate or butryate), methyl, isopropyl and tributyl branching, primary alcohols
*	*	5 Aromatics, carbonyls, aliphatic hydrocarbons
*	*	6 Split carbonyls; methyl, isopropyl and tributyl branching; secondary alcohols; esters; possible 5C ring lactones; branched cyclic alcohols
*	*	7 (No assignment made)

* Spectra are provided in the "additional data" section; wave numbers and intensity were not reported.

OTHER REMARKS:

TABLE 7- 17
IR REPORT

SAMPLE: Site A tar extract

Wave Number (cm^{-1})	**Intensity**	**Assignment/Comments**
		LC Fraction Number
*	*	1 Aliphatic hydrocarbons ($-CH_2-$)>4, some branched
*	*	2 Substituted aromatic with alkyl and branched
		alkyl substituents
*	*	3 Substituted aromatic with alkyl and branched
		alkyl substituents
*	*	4 Same as above plus NH stretch
*	*	5 Same as above but probably OH stretch, trace
		C=O
*	*	6 Bonded OH and NH stretch
*	*	7 Primary OH, water of hydration, CO ether, ester
		(acetate), split carbonyl (possible acid)
*	*	8 Split >C=O (acid and ester), water of hydration,
		possible ester (acetate), aliphatic, methyl
		group.

* Spectra are provided in the "additional data" section; wave numbers and intensity were not reported.

OTHER REMARKS:

ADDITIONAL DATA

Photomicrographs (optical and SEM) were shown for the following samples:

1. Cyclone dust from site A
2. Cyclone dust from site A showing spherical segments
3. Cyclone bottom dust from site A
4. Particulate residue from tar
5. Cyclone dust from site A (bituminous coal), site B (anthracite coal), and site C (bituminous coal)
6. Same as No. 5 but with different view of field
7. Residue from site A tar (particulates that passed through the cyclone)
8. Dust from site B that passed through the cyclone
9. Deposits on walls of product gas main downstream of the site C cyclone
10. Particulate residue in tar (site C)

Table 4-1. ORGANICS EXTRACTED FROM SITE A QUENCH LIQUOR

Step		mg/ℓ	% of total extracted
1	Methylene Chloride Extractable	2231	57.7
2	Ether Extractable[a] at pH 7	1457	37.6
3	Ether Extractable[b] at pH 1	177	4.7
	TCTAL EXTRACTED	3865	100

[a] Following Step 1

[b] Following Steps 1 and 2

Table 4-6. ORGANIC EXTRACTABLES IN SITE A TAR

Extractables In Tar	grams	% of sample
Weight of Sample	0.50209	--
Weight of Extracted Organics	0.33583	66.9
Loss-on-Extraction/Evaporation	0.16625	33.1
Insoluble Residue	0.0200	4.0*

*3.9% on the medium frit + 0.1% on the filter paper

Table 4-11. RESULTS OF DRY SCREEN TEST OF SITE A CYCLONE DUST

Sieve No.	Particle size (dp [μ])	wt %	Cumulative
10	>2000	0.3	100.0
18	>1000	0.2	99.7
25	> 710	0.1	99.5
40	> 425	3.1	99.4
60	> 250	18.9	96.3
80	> 177	22.3	77.4
100	> 149	17.9	55.1
120	> 125	6.9	37.2
140	> 106	7.6	30.3
200	> 74	11.6	22.7
230	> 63	3.8	11.1
400	> 37	4.6	7.3
-400	< -37	2.7	2.7

Table 4-12. ELEMENTAL COMPOSITION OF SITE A CYCLONE DUST

Element	Wt. Percent
Carbon	84.42
Hydrogen	1.62
Nitrogen	1.07
Sulfur*	0.67
Residue on Ignition (ROI)	10.19
Total (approximate)	98%

*Schoeniger flask method includes organic sulfur and soluble forms of inorganic sulfur.

Table 5-1. SOURCES OF PARTICULATES

Site	Fuel	Sampling Location
(1) A	Bituminous	Cyclone Bottom
(2) A	Bituminous	Through Cyclone*
(3) B1	Anthracite	Cyclone Bottom
(4) B3	Anthracite	Through Cyclone**
(5) C1	Bituminous	Cyclone Bottom
(6) C1	Bituminous	Through Cyclone**

* Suspended in tar.

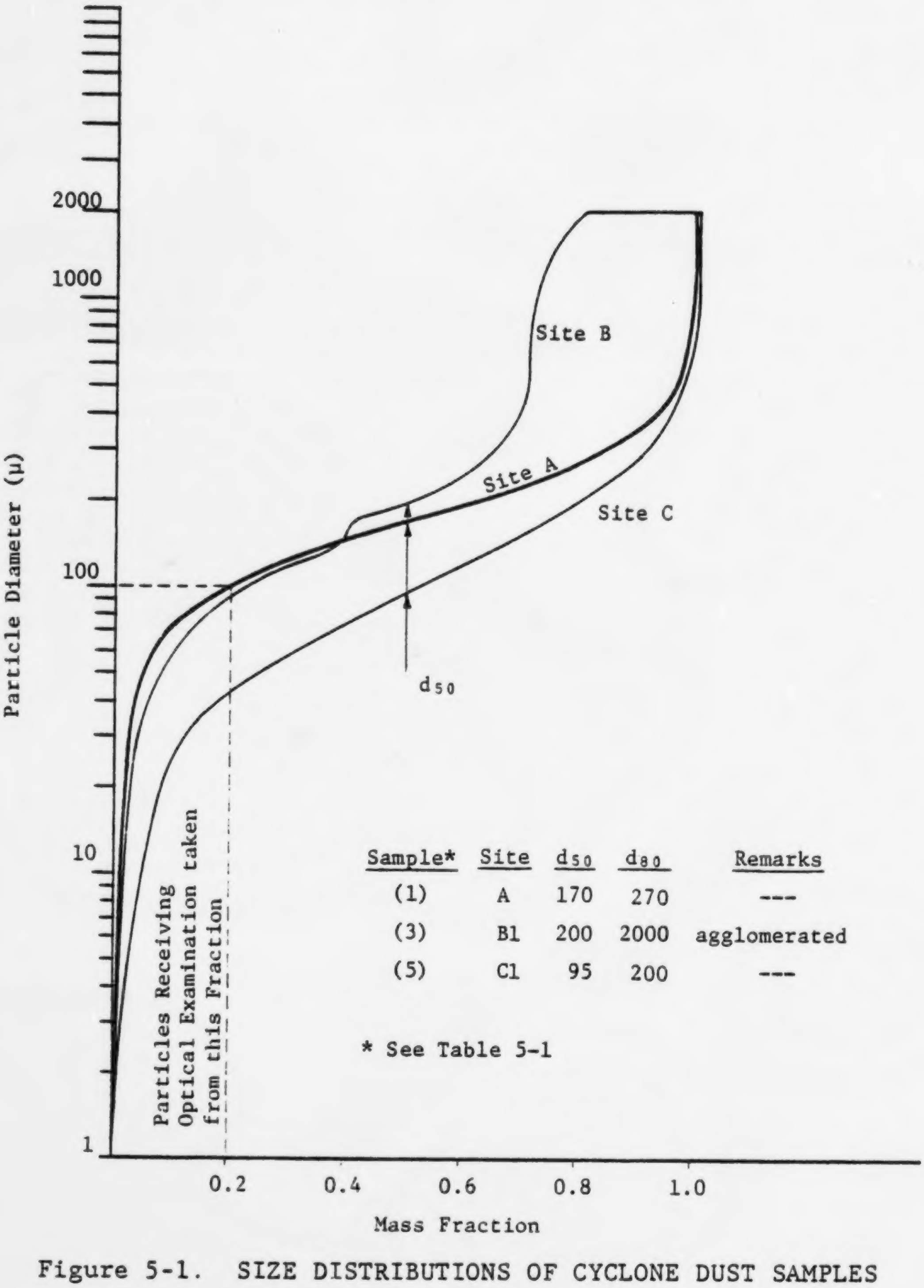
** Removed from gas duct downstream of cyclone.

( ) Numbers relate to columns in Table 5-2.

Table 5-2. COMPARISON OF PARTICULATE MATTER

Sample Location Key	(1) Site A	(2) Site A	(3) Site B1	(4) Site B3	(5) Site C1	(6) Site C1
Nominal**dp, μ	170	2-20	200.0	<1*	95.0	≈20μ
Moisture	--	--	10.5	3.3	0	--
Ash (Dry Bases)	10.19	--	47.28	54.73	15.4	10.4
Bulk Density	0.40	--	0.93	--	0.53	0.31

*Agglomerated **d_{50} (See Figure 5-1.)



Sample*	Site	d_{50}	d_{80}	Remarks
(1)	A	170	270	---
(3)	B1	200	2000	agglomerated
(5)	C1	95	200	---

* See Table 5-1

Figure 5-1. SIZE DISTRIBUTIONS OF CYCLONE DUST SAMPLES FROM SEVERAL SITES.

First Extraction

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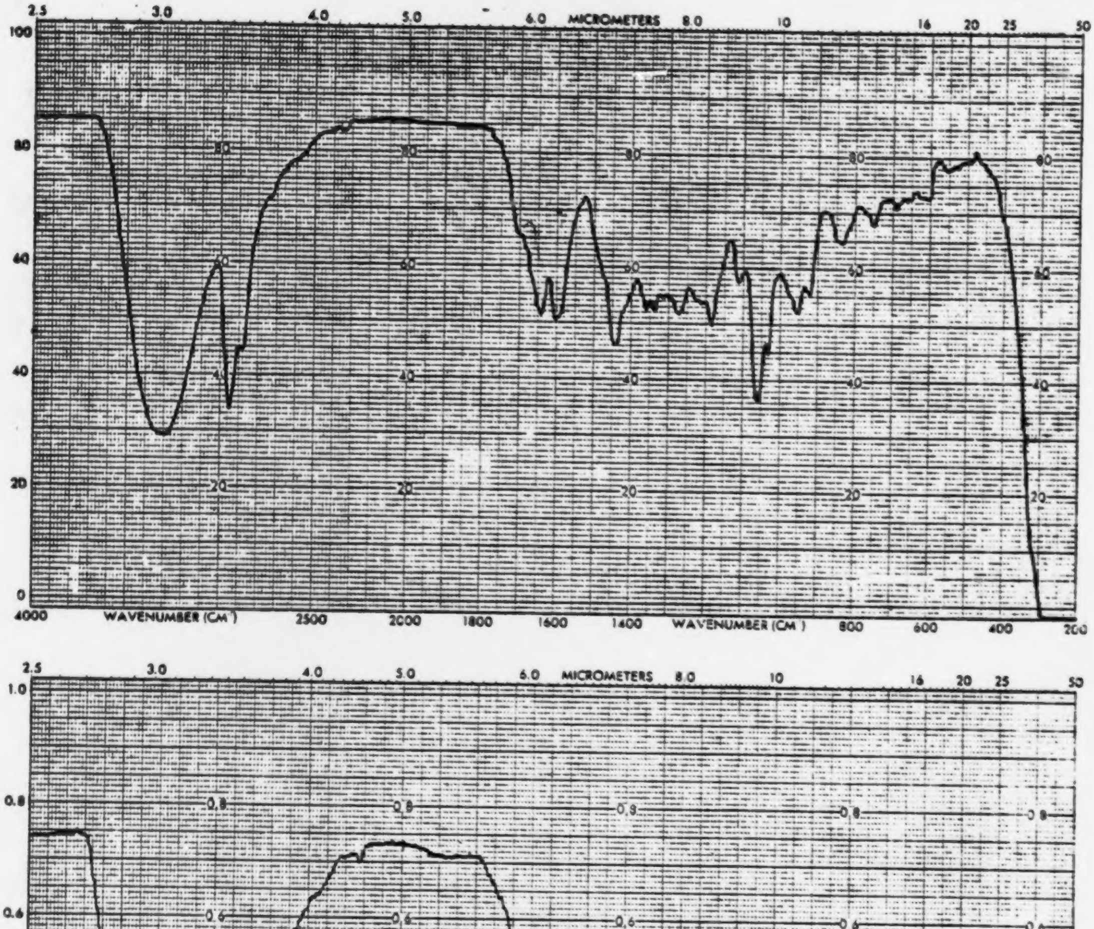

Figure 5-8. METHYLENE CHLORIDE EXTRACT OF QUENCH WATER
Top: Site C Bottom: Site A

Second Extraction

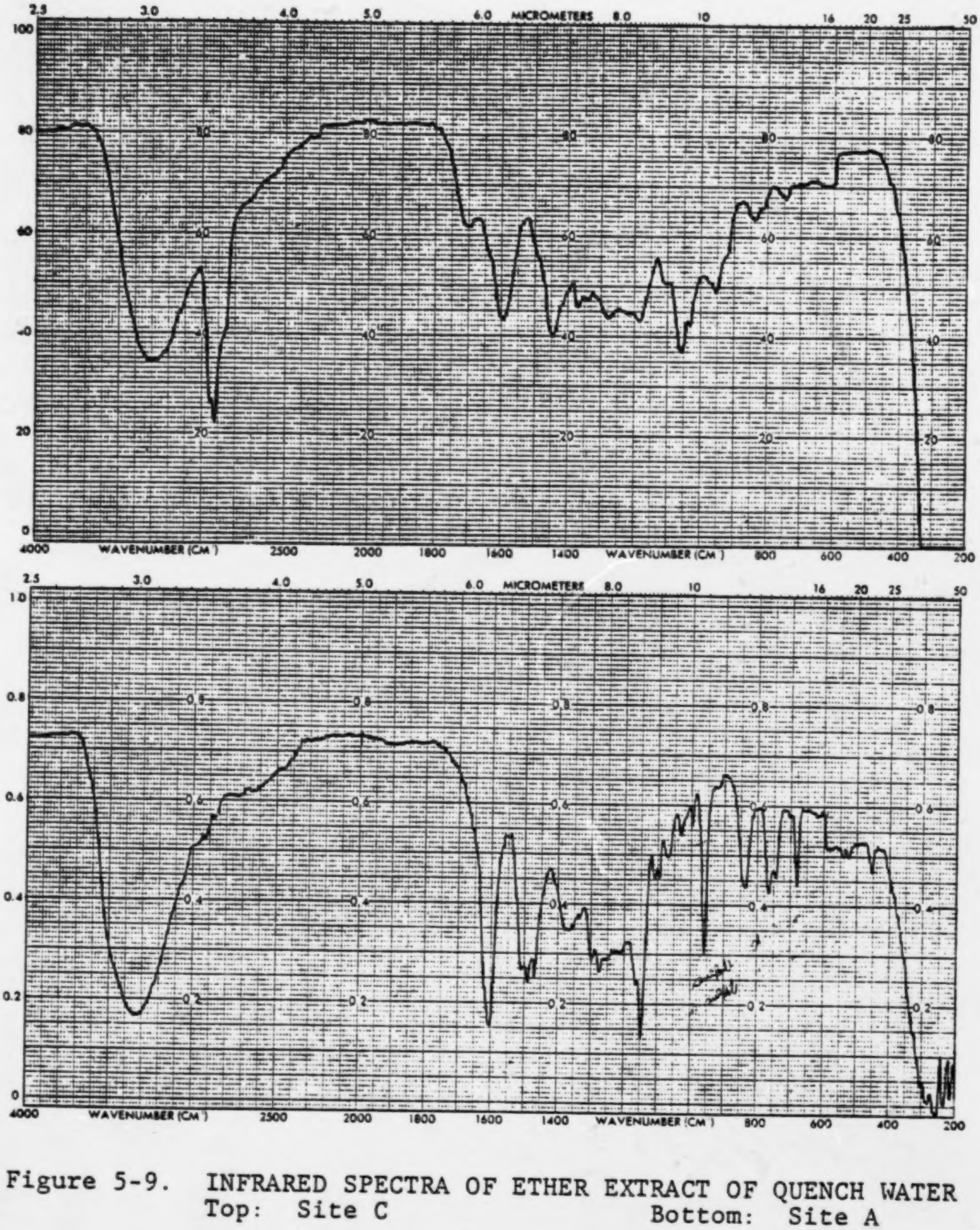

Figure 5-9. INFRARED SPECTRA OF ETHER EXTRACT OF QUENCH WATER
Top: Site C Bottom: Site A

Third Extraction

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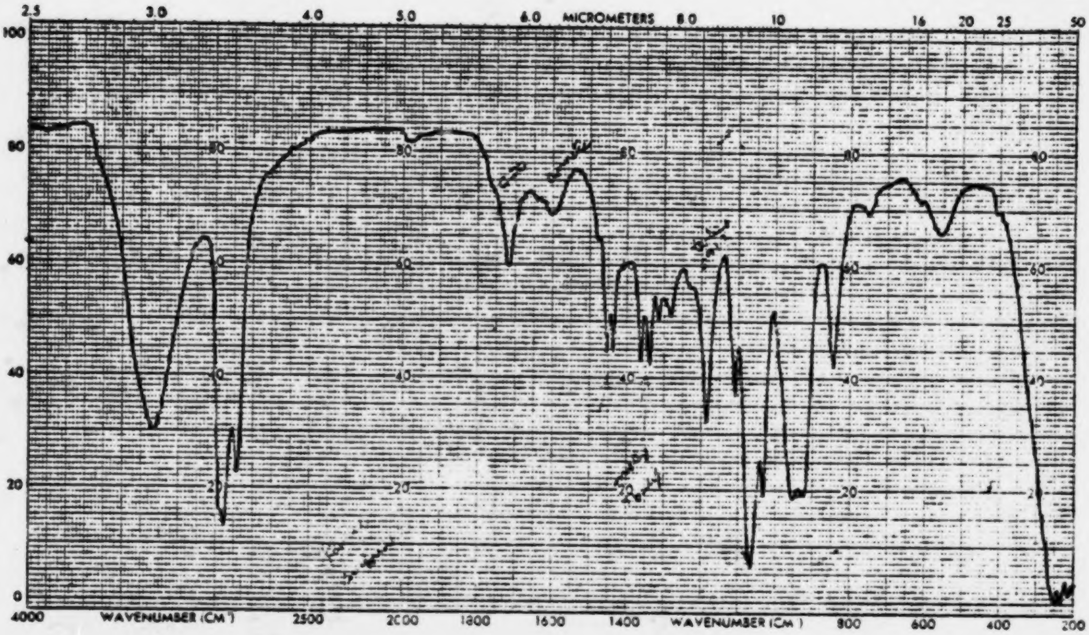

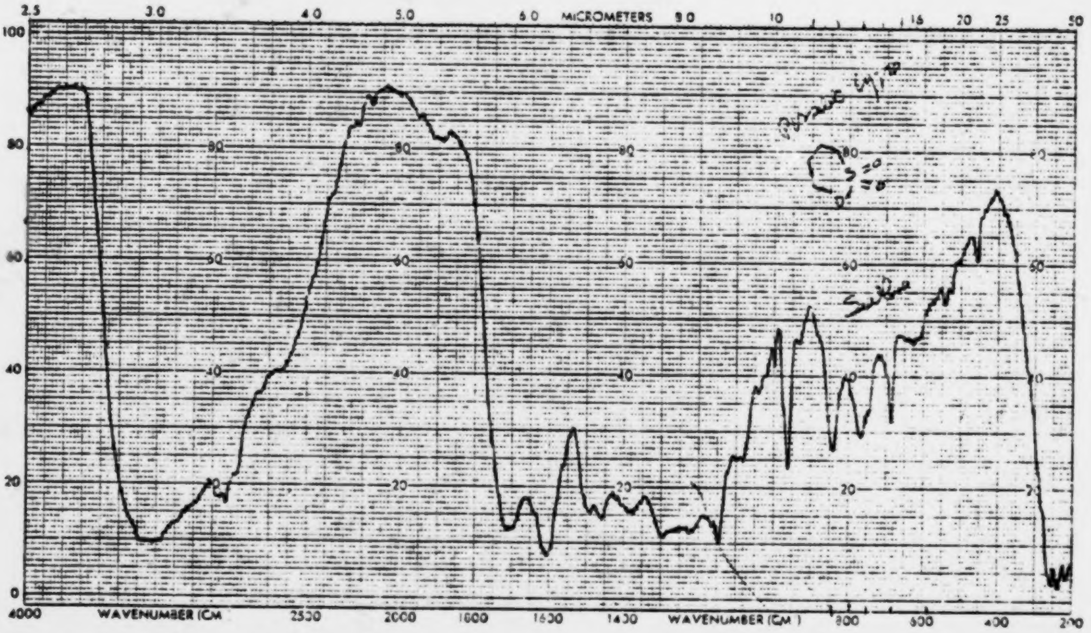

Figure 5-10. ETHER EXTRACT OF ACIDIFIED QUENCH WATER
Top: Site C Bottom: Site A